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HABITS OF WATERLILY SEEDLINGS.

BY J. A. NIEUWLAND.

[Plate XIV]

During several weeks study of an abundance of *Nuphar* and *Brasenia* material at Bankson Lake, Van Buren Co., Mich., in the late summer of 1914 and 1915 some interesting details of the habit of seedlings of these plants were obtained. The plants by their great number and peculiar response to the various environments to which they were subject, appeared particularly in congenial conditions for study of variations in development.

Noteworthy additions to our knowledge of *Nymphaea* seedlings as to habit and method of germination were brought out by Conard[1] in his Monograph on these plants. Seedlings of *Nymphaea tuberosa* Paine, [*Castalia tuberosa* (Paine) Greene] at Bankson Lake showed conditions of growth and response to surroundings as were outlined by Conard, and the members of the white waterlily group having been so thoroughly treated by that author only a few notes need here be added regarding leaf variation of the seedling of this plant. Sprouting tubers of the various members of the *Nymphaea* group such as *N. gigantea*, *N. mexicana*, *N. flavovirens*, *N. flava*, *N. elegans*, *N. zanzibarensis* var. *rosea* and a hybrid have their leaves shown on p. 75 bringing out a remarkable variety of these submersed members.

These plants have two very distinctly different kinds of leaves. The submersed aquatic, depending upon their age or succession of development and the depth in the water, show a tendency to enlarge and become broader. Smaller forms are found in shallow water where the penetration of light rays is

[1] Conard, H. S. The Waterlilies, a Monograph of the Genus *Nymphaea* Carn. Inst. Wash. (1905).

not cut out by silt and side refraction of the medium. These submerged leaves are, moreover, very thin, and when dried even filmy and easily broken and blown away by the slightest gust of air. Histologically the cells are more alike and more spherical or ovoid in shape. Their vascular tissue is reduced to a minimum since scarcely necessary, except the phloem part. The floating leaves are produced later and at any one time are fewer and smaller, quite thick, in fact miniatures in every way of those of the mature plant. Usually not more than two or three are found on one plantlet and oftener, but one in small specimens. Conard does not emphasize, as might be done, the variation of shape of the successive seedling leaves. As already referred to he selects aquatic leaves from the sprouting tubers rather than from seedlings, and whatever leaf variation in stages are taken up (p. 110) are at random picked from different species not serially shown as to age or successive appearance.

Examination of hundreds of seedlings of different ages of *Nymphala tuberosa* showed us that the different leaf forms of this one species vary as much if not more than of the tuberous growths. Such a series of aquatic leaf variations have been selected as typical from the so-called "coves" of Bankson Lake, and the originals kept in the University herbarium, and illustrated in figures 1–10 plate XIV. The dotted outlines indicate other forms from the type connected with them. The order of appearance in the growing seedling varies as the breadth of the leaf and the size of the basal lobe, the very earliest devoid of blade, the earlier narrow and quite devoid of lobes. The second leaf is usually narrowly lanceolate or linear (Fig. 1). A curious fact is the presence even on the same plantlet of sharp angular sinus at the insertion of the petiole (4, 5, 9, 10,) and rounded or even obtuse protrusion at place of insertion in these submerged seedling leaves. Fig. 5 represents that might well be taken for a specimen of the *Nuphar* group, but for the fact that other leaves on the same plant are unequivocally those of *Nymphaea*, and the adhering seed coat could not be mistaken. The seeds of *Nuphar* are large and shiny, those of *Nymphaea* small and black, those of *Brasenia* small and grayish white, both of the latter dull. The method of germination of *Nymphaea* seedlings were found to be the same as outlined by Conard.[2]

[2] l. c. p. 107:112.

BRASENIA SCHREBERI.

Seedlings of *Brasenia* in great numbers were studied and found to have the same mode of germination as those of *Nymphaea*. [Plate XIVa.] The following variations due to environment were observed. Seeds [S] embedded in mud often as much as four to six inches break open by protrusion of the cotyledon petioles carrying out the axil, from which the epicotyl arises as a long thread-like growth. The more or less delayed primary root passes downward [PR]. The epicotyl [EP] when reaching the surface of the mud or bottom of the pond, expands and produces a cluster of leaves of varying size but with the exception of the first few, of about the same shape. The cotyledons are permanently intraseminal and seem to serve no purpose except to suffer the transfer of food collected in them, to the seedling especially to the primary root and epicotyl until it has produced leaves. While so doing the cotyledons gradually wither away. All the submerged leaves are thin, and filmy when dried, and histologically nearly as in *Nymphaea*. The first blade-bearing leaf is narrowly oblong and the petiole is *not peltately inserted, but at the margin of one end*. The subsequent leaves are excentrically peltate the earlier ones just slightly intra-marginally inserted. The size of the leaves beneath the water depends on the depth of submersion, the plants in deep water bearing very large ones. After about 6–9 of these thin aquatic leaves have appeared, there arises a single smaller perfectly elliptical floating one [W] which is thick in texture and except for the absence of slimy exudation on the lower face characteristic of mature floating foliage and petiole, is quite a miniature of the older leaves. The stalk is very long, whereas the petioles of leaves of older plants are short, and the whole plant, stem and leaf cluster of maturer specimens arise to the surface of the water. The plants continue a succession of these long stalked floating leaves until a stem rises from the rooting plantlet, when the newly developed foliage begins to produce the slimy covering of the young immersed parts. *Brasenia* seeds not embedded in mud at the bottom, germinate without growing an elongated epicotyl, the seedling appearing to come almost directly from the axils of the cotyledons. It is not likely that seeds of this plant or *Nymphaea* would develop on or in mud above the water line. Such specimens could not be

found as was the case with *Nuphar*, giving rise thus to a new response to a new environment in the last named plant.

NUPHAR ADVENA.

Two distinct species of Yellow Pondlilies were found in Bankson and North Bankson Lakes. Both are abundant in sheltered muddy parts of the lakes called "coves." So readily were they distinguished at sight that my attention to the main differences was first called by a companion who had never studied botany. *Nuphar advena* grows nearer to shore as a rule but even in very deep location lifts its leaves entirely out of water. *Nuphar variegata* grows nearly always in deep places and the leaves always float. The petioles of the former are stout oval or almost orbicular in cross section and the basal sinus is open with wide spreading lobes. The lobes of the later are closed and the semicircular outline of petiole cross section shows two noticeable projections representing wings.

Fernald and St. John[1] consider Standley's estimate as to the size of the "floating leaves usually 17–28 cm. long and 11–22 cm. wide" "as unfortunate" or apparently extravagant. From herbarium specimens it is not always safe to conclude as to leaf-size, even if such a character means very much in some plants. There is a decided tendency not to collect the older and the largest leaves of plants, because they are in case of water plants especially, inconvenient to mount, or defective or broken by wind and eaten by insects. My herbarium specimens of these plants were very carefully made in the last few years, yet not with the idea of obtaining the largest sizes, though the largest young and perfect ones. Average sizes were obtained and their length is from 15–30 cm., and they are proportionately wide. I have seen numerous plants with older but torn leaves that were no less than 35 cm. long!

The rhizomes of both species of *Nuphar* can not be distinguished. The specimens of skins of those of *N. variegata* show perhaps closer arrangement of leaf insertions in phyllotaxy, and are found deeper in the mud, the roots usually arising only from the lower side in both. I have been unable to find aquatic foliage in blooming plants late in season, though in vegetative specimens of *N. variegata* such was occasionally met with. The flowers of

[1] Rhodora 16: 138 (1914)

the latter are notably larger and darker red and the stamens much more numerous. The crenate margined stigma has the lines in flower running to the edge, whereas in *N. advena* these do not reach the margin by one third or one fourth their length. The fruits of the last mentioned are deeply cratered and scarcely narrowed abruptly at the top. Whereas the fruits of the yellow pond lilies ripen above water or bend down eventually, the fertilized flowers of *Nymphaea tuberosa* are pulled down close to the bottom as the peduncle twists into a close spiral after the manner of *Valisneria* pistillate-flowered peduncles.

It was found impracticable to study seedlings of *N. variegata* because the plant always grew where *N. advena* was also found. There were, however, many places where the latter was exclusively to be found so that the seedlings obtained are with certainty those of the latter. Moreover, the plantlets of *N. variegata* which were indisputably such, were already too far advanced to show results, and too few to be worth while.

The seedling of *N. advena* exhibits more differentiation in response to environment than any of the other water lilies. Like those of *Brasenia* and *Nymphaea*, seeds of *Nuphar* buried in mud either at the bottom of the pond [b.e.] or above the water line [f] send out an elongated epicotyl with the primary root. On emerging from the darkness in the mud, aquatic leaves are produced which are thin and evanescent, their size varying as the depth of water or consequent absence of strong light. The first blade-bearing leaf is narrowly lanceolate to linear and the succeeding ones become broader and more orbicular and finally cordate obtuse at the apex or rounded, with reniform base, and with more or less rounded basal lobes. When found in deep water the submerged leaves are in texture and size like those of *Nymphaea tuberosa*, but of a yellowish green color. Leaves of plantlets of the same age in shallow clear water [d] are darker green and smaller. Seeds of the plant [c] not embedded in the mud of the bottom do not produce the characteristic elongated epicotyl. All *Nuphar* seedlings produce after the usual set of submerged leaves, one or two thick smaller floating leaves, as in *Brasenia* and *Nymphaea*. These are approximately miniatures as to shape and structure of mature leaves, but as they always float, they have no stomata on the lower face. An interesting characteristic of seedlings of *N. advena* not found in the others, *Nynphaeceae*

not even in case of *Nuphar variegata*, is that the seeds germinate above the water line in or on mud. In this case no aquatic foliage whatever is produced [e.f.]. The leaves are the usual thick aerial ones with short stout petioles. They are even firmer and proportionately smaller than the floating ones. Even when not germinating below the water line, but when embedded in mud the seeds send out the elongated epicotyl [f.]. *N. advena* alone seems to have this last environment. The variation of shape in these aerial leaves is also a gradual one, the very earliest, however, are never as narrow as the younger aqautic ones. In fact should the water of a pond lower and leave plantlets with one or two aquatic thin leaves exposed to air, no more aquatic foliage is produced, but only aerial thicker leaves. Such changes from water exposure to air exposure of foliage and back again are rapid and frequent, due to the fact that the rise and fall of the so-called "floating islands" or musk-rat feeding-places occur. These animals undermine large patches of root-entangled bottom which rises and small islands float about. As the other plants on them die these patches often sink again. Around the muskrat "runs" these "floating islands" dip abruptly into deep water, and all the stages of *Nuphar* seedling environment may be found within the area of single square yard.

North Bankson Lake is muddier than the other lake as it has in very recent times been cut off by a sand-bar raised by wind and wave action. It is now much more sheltered and has rather large areas of these "floating islands" which have become a tangled mass of roots of *Carices, Cyperi, Scirpi, Junci, Eripohorum* and principally *Rhychospora macrostachya, Dulichium arundinaceum Hermicarpha micrantha, Fuirena squarrosa*, one or two species of *Fimbristylis* and *Eleocharis*, many tall grasses *Xyris flexuosa, Peltandra virginica, Sparganium minimum, Eriocaulon septangulare*, and nearer the water line, *Utricularia intermedia* and *minor* growing with *Nuphar advena* seedlings. It is very unsafe to venture upon these patches without the aid of planks as they are real floating quagmires. Changes in environment to meet rapidly varying conditions are so frequent that the *Nuphar* seedlings accommodate themselves apparently to all the habitats in rapid succession. I have even found *Nuphar advena* seeds germinating in the almost dry drained bottom of a pond south of South Bend, where the older plants deprived of sufficient moisture were rapidly drying off.

PLATE XIV.

EXPLANATION OF FIGURES.

FIG. a. *Brasenia Schreberi* Gmel. Seedling illustrating habit of growth with thin aquatic submersed foliage and one quick floating leaf (W) when the seed germinates below the muddy bottom (BB¹). Ep Elongated epicotyl. (S), Seed, (PR), Primary root. (W) Thick aërial leaf. The other habitats are similar to the following of Figs. (b), (c), and (d).

FIG. b. *Nuphar advena* (Soland) R. Br. Seedling showing aquatic and floating leaves, and habit of the preceding. Parts labelled as in Fig. a.

FIG. c. Same with seed germinating at the bottom on the mud but not buried. No elongated epicotyl developed.

FIG. d. Same showing diminution in size of aquatic foliage when growing in shallow water with stronger light.

FIG. e. Same with aërial thick foliage when growing in mud above the water line (WW¹).

FIG. f. Same the seed germinating upon instead of below mud. Foliage as in the preceding (Fig. e); no aquatic leaves developed.

FIGS. 1–10. Variations in aquatic leaf shapes of seedlings of *Nymphaea tuberosa* Paine. The older leaves are broader with larger basal lobes.

All plants about ½ to ¾ natural size. Drawing diagrammatic, the petioles of all naturally longer, particularly in case of floating foliage. Petioles of the air-exposed plants (Figs. e and f.) drawn in natural proportions. All plants drawn from herbarium specimens collected at Bankson and North Bankson Lakes in August, 1915.

ENUMERANTUR PLANTAE DAKOTAE SEPTENTRIONALIS VASCULARES.—IV.

ENUMERAVIT J. LUNELL.

The Vascular Plants of North Dakota.—IV.

With Notes by J. Lunell.

Sub-class 2. DICOTYLEDONEAE.

D. C. Syst. I., (1818), also Prodr. I., p. 1. (1814).

Order 16. SALICINAE.

Bartling, Ord. Nat. Pl. p. 118. (1830.)

Family 29. **SALICINEAE** L. Rich ex A. Rich. Nov. El. Bot. ed. 4, p. 560. (1828), also Lindley, Nat. Syst. ed. 2, p. 186. (1836).

POPULUS Virgilius Ecl. IX. 41, Plinius XXIV, 8, Horatius, Carm. 11. 3.

302. **Populus tremuloides** Michx. Fl. Bor. Am. 2. 243. (1803).

No trees surpass or equal this in the tendency of forming natural groves whenever it has the slightest opportunity. No other tree seeds itself on the open prairie.

Leeds, Butte, Dunsieth; Kulm (Brenckle).

AIGEIROS Homeros, Odyss. VII: 106, XVII: 208. Hesiodus, Scut. Herc. 377. Theophr. III: 14. Diosc. I: 144.

303. **Aigeiros deltoides** (Batr.) Tidestrom, Elysium Marianum II, p. 16. (1910).

Populus deltoides Batr.: Marsh, Arb. Am. p. 106. (1785).

Everywhere in cultivation, and, when indigenous, growing in such protected places as railroad ditches, ravines, etc. Leeds.

304. **Aigeiros Sargentii.**

Populus Sargentii.

A tree "easily recognized by the pubescent winter-buds and by the light yellow color of the branchlets." It ought to grow "especially in the western part of the state." (The citations are from a letter by Prof. C. S. Sargent.)

305. **Aigeiros balsamifera** (Linn.) Lunell.

Populus balsamifera Linn. Sp. Pl. 1034. (1753).

An indigenous tree. Turtle Mountains.

306. **Aigeiros candicans** (Ait.) Nwd. in Am. Midl. Nat. Vol. III, p. 223.(1914).

Populus candicans Ait. Hort. Kew. 3. p. 406. (1789).

Escaped from cultivation. Leeds.

SALIX Virgilius Ecl. II: 83, V: 16, X: 140, Georg. IV: 184, Culex 54. Plinius. Nat. Hist. XXI: 20.

307. **Salix vitellina** Plinius XVI: 37. Linn. Sp. Pl. ed. 2, 1442. (1763).

Cultivated like the following and often escaping. Leeds.

308. **Salix vitellina aurea.**

A variety widely used for hedges. Leeds.

309. **Salix amygdaloides** Anders Ofv. Sv. Vet. Akad. Förhandl. 15:114. (1858.)

Leeds, Minnewaukan.

310. **Salix lucida** Muhl. Neue Schrift. Ges. Nat. Fr. Berlin 4:239, p. 6, f. 7. (1803).

In the Willow Creek ravine near Dunsieth.

311. **Salix interior** Rowlee, Bull. Torr. Bot. Club, 27, p. 253. (1900).

Salix longifolia Muhl. l. c. 238. (1803), not Lam. (1778).

The most common willow in the state. Leeds, York.

312. **Salix linearifolia** Rydb. in Britt. Man. 316. (1901).

Sand hills near Willow City (Bottineau Co.).

313. **Salix bebbiana** Sargent, Gard. and For. 8:463. (1895).

Salix rostrata Richards. Frank. Journ. App. 753. (1823). Not Thuill. (1799).

One form coming very near to *S. perrostrata* Rydb. was found by the writer in Benson Co. 1906, and deposited in the Herbarium of Harvard University.

Leeds, Butte.

314. **Salix humilis** Marsh. Arb. Am. 140. (1785).

Butte.

315. **Salix discolor** Muhl. l. c. 234, pl. 6, f. 1. (1803).

Butte.

316. **Salix petiolaris** J. E. Smith, Trans. Linn. Soc. 6, p. 122 (1803.)

Butte.

317. **Salix candidula** Nwd. in Am. Midl. Nat. Vol. III. p 225. (1914).

Salix candida Fluegge in Willd. Sp. Pl. 4, p. 708. (1806), not Plinius l. c. = *Salix vitellina.*

In boggy ravine, Butte. In deep gravel near Willow City, (Bottineau Co.).

318. **Salix candidula x petiolaris.**

Only one shrub in boggy ravine, Butte.

319. **Salix chlorophylla** Anderss. Ofv. Sv. Vet. Akad. Förhandl. Stockh. 6. 138. (1867).

Kulm (La Moure Co.). Perhaps my identification is incorrect.

320. **Salix cordata** Muhl. l. c. p. 236. p. 6, fl. 3. (1803).

Leeds, Butte, Peninsula of Lake Ibsen, Bismarck.

Order 17. AMENTACEAE.

(*Ray, Boerhave*) *Gmelin, Fl. Sibir. I: 150.* (*1747*); Juss. Gen. 407. (1789); Bartling, Ord. Nat. Pl. 96. (1830).

Family 30. **CORYLACEAE** Mirbell ex S. F. Gray, Nat. Arr. Br. Pl. II. p. 244. (1821), in part.

OSTRYA Plinius XIII: 21.

321. **Ostrya virginiana** (Mill.) Willd. Sp. Pl. 4:469. (1805).

Carpinus virginiana P. Miller, Gard. Dict. ed. 8. (1768).

Fargo, (Lee, O. A. Stevens).

CORYLUS Virgilius Ecl. I: 14, II: 3; Georg. II: 69 and 209, Plinius XVI: 18, Caesalpinus De Plantis 38. (1588). Tour. Els. 453. (1694). Linn. Syst. (1735).

322. **Corylus americana** Walter, Fl. Car. 236. (1788).
Turtle Mountains in Bottineau Co.

323. **Corylus rostrata** Ait. Hort. Kew 3:364. (1789).
Turtle Mountains: Dunsieth, St. John.

Family 31. **BETULACEAE** Agardh, Aphor. 208. (1825), also Bartling, Ord. Nat. Pl. p. 99. (1830).

BETULLA Plinius XVI: 30.
Betula Tragus. Matthioli, Dodonaeus, etc.

324. **Betulla papyrifera** Marsh. Arb. Am. 19. (1785), (cor.).
Turtle Mountains: Dunsieth.

325. **Betulla papyrifera cordifolia** Fernald, (cor.).
Pleasant Lake, Turtle Mountains.

ALNUS Plinius XVI: 24. Brunfels, Tragus, Tour. Els. 459. (1694), Duhamel, Arb. et Arbustes 41. (1755).

326. **Alnus incana** C. Bauhin ex. J. Bauhin, Hist. 6, p. 157. (1650).
Neche (H. L. Bolley).

Family 32. **GLANDIFERAE** Theodore Gaza, De Hist. et Causis Plantar. (1529), also Caesalpinus De Plantis p. 31. (1583).

QUERCUS (Lucretius), Virgilius, Ecl. I: 17, IV: 30, VI: 13, Georg. I: 349, II: 16, III: 332, Culex, 132, Tour. Els. p. 454. (1694).

327. **Quercus macrocarpa** Michx. Hist. Chen. Am. 2:23 (1801).
Minot, Pleasant Lake, Turtle Mountains.

328. **Quercus macrocarpa depressa** Engelm.
Dunsieth.

Order 18. URTICALES.

Engl. Syllab. ed. I. p. 95. (1892).

Family 33. **ULMACEAE** Mirbel, Él. II:905. (1815).

ULMUS Virgilius. Ecl. II: 70, V:3, Georg. I:170, II:18, 72 222, IV: 144. Tour. Éls. p. 473. (1694).

329. **Ulmus americana** Linn. Sp. Pl. 226. (1753).
Towner, Turtle Mountains. In cultivation at Leeds.

CELTIS Plinius XIII: 17. Tour. Éls. p. 485. (1694).

330. **Celtis crassifolia** Lam. Encycl. 4, 6, 138. (1797)
Peninsula of Lake Ibsen; Logan Co. (Brenckle)

Family 34. **CANNABINACEAE** Lindl. Veg. Kingd. 265. (1846).

LUPULUS J. de Manliis ex Brunfels Herb. Viv. Ic. 2: 169. (App.) (1531); Tour. Éls. p. 427. (1694.)

331. **Lupulus salictarius** Dodonaeus. Trium Prior. Stirp. Hist. p. 386. (1553).

Humulus Lupulus Linn. Sp. Pl. 1028. (1753).

Turtle Mountains, Pleasant Lake, Towner, Minot.

CANNABIS Dioscorides III: 157, Plinius XIX: 4, 9, XXI: 23. Tour. Éls. p. 427. (1694).

332. **Cannabis sativa** (Dioscorides) Marcellus Virgilius Comment. Diosc. p. 453. (1529).

Richland Co. (W. B. Bell.)

Family 35. **URTICEAE** Ventenat. Tabl. Reg. Veg. 524. (1794).

URTICA Plinius XXII: 13; Tour. Éls. p. 426. (1694).

333. **Urtica gracilis** Ait. Hort. Kew. 3:341. (1789).

Leeds, Towner.

334. **Urtica Lyallii** S. Wats. Proc. Am. Acad. X. 348. (1875).

Pleasant Lake.

LAPORTEA Gaudich, Freyc. Voy. Bot. 498. (1826).

Urticastrum Moehring, Hort. Prov. (1736), also Fabricius, Enum 204. (1759). Undesirable name because built on *Urtica*.

335. **Laportea divaricata** (Linn.) Lunell.

Urtica divaricata Linn. Sp. Pl. 985. (1753). *Urtica canadensis* Linn. l. c. *Laportea canadensis* (Linn.) Gaudich. l. c. *Urticastrum divaricatum* (Linn.) Kuntze, Rev. Gen. Pl. 635. (1891).

Towner on the banks of Mouse River.

ADICEA Raf. Ann. Nat. 179. (1815).

336. **Adicea fontana** Lunell, Am. Midl. Nat. Vol. III., p. 7. (1913).

Pleasant Lake.

337. **Adicea opaca** Lunell, Am. Midl. Nat., Vol. III., p. 8. (1913.)

Pleasant Lake.

HELXINE Dioscorides IV: 86.

Parietaria Brunsfels, 2. (1531): Tour. Éls. 409. (1694).

338. **Helxine pennsylvanica** (Muhl.) Nwd. in Am. Midl Nat. Vol. III. p. 235. (1914).

Parietaria pennsylvanica Muhl. Willd. Sp. Pl. 4. p. 155. (1806)

Williston (O. A. Stevens); Wahpeton; Morton Co

Order. 19. SANTALALES.

Engler, Syllab. ed. I. p. 98. (1892).

Family 36. **SANTALACEAE** R. Br. Prodr. p. 350. (1810).

COMANDRA Nuttall, Gen. I: 157. (1818).

339. **Comandra pallida** A. DC. Prodr. 14:636 (1857).

Leeds, Butte.

Order 20. FAGOPYRINAE.

Bartling, Ord. Nat., p. 106. (1830).

Family 37. **POLYGONEAE** Juss. Gen. p. 22. (1787).

ERIOGONUM Michx. Fl. Bor. Am. I: 246. (1803).

340. **Eriogonum annuum** Nutt. Trans. Am. Phil. Soc. (II.), 5:164. (1833–37).

Pretty Rock (W. B. Bell).

341. **Eriogonum multiceps** Nees, Max. Reise N. A. 2:446. (1841).

Morton County (W. B. Bell).

342. **Erigonum crassifolium** Benth. Trans. Soc. Linn. 17:408 (1837).

Dunsieth, Minot.

RUMEX Virgilius, Mov. 72: Plinius XIX: 12,60.

343. **Rumex Acetosella** Linn. Sp. Pl. 338. (1753).

Willow City, (Bottineau Co.).

LAPATHUM Theophrastus I: 9, 7: 2. Dioscorides II: 140. Gesner. Anguillara, etc. Tour. Els. p. 404. (1694).

344. **Lapathum venosum** (Pursh) Lunell.

Rumex venosus Pursh, Fl. Am. Sept. 733. (1814).

345. **Lapathum mexicanum** (Meisn.) Nwd., Am. Midl. Nat. Vol. III., p. 237. (1914).

Rumex mexicanus Meisner, DC. Prod. 14: 45. (1856).

Rumex salicifolius Hooker, Fl. Bor. Am. 2: 129. (1840). Not. Weinm. (1821).

Leeds, Butte.

346. **Lapathum occidentale** (S. Wats.) Lunell.

Rumex occidentalis S. Wats. Proc. Am. Acad. 12:253. (1876).

Peninsula of Lake Ibsen, Butte.

347. **Lapathum crispum** (Linn.) Scopoli, Fl. Car. ed. 2:261. (1772).

Rumex crispus Linn. Pl. 335. (1753)

Leeds.

348. **Lapathum persicarioides** (Linn.) Moench, Meth., 355 (1794).

Rumex persicariodes Linn. Sp. Pl. 335. (1753).

Peninsula of Lake Ibsen, Butte.

FAGOPYRUM Lobelius Obs. 513. (1576). Dodonaeus, Pempt. 4:1: 32. (1583). Tour Els. p. 411. (1694). Gaertner (1791).

349. **Fagopyrum vulgare** Hill. Br. Herb. 486. (1756).

Fagopyrum esculentum Moench. Meth. p. 290. (1794).

Leeds.

350. **Fagopyrum tataricum** (Linn.) Gaertn. Fr. et. Sem. 2:182, pl. 189, f. 6. (1791).

Polygonum tataricum Linn. Sp. Pl. 364. (1753).

Leeds, (extinct).

RHEUM Linn.

351. **Rheum Rhaponticum** Linn. Sp. Pl. 531. (1753).

Ecsaped. Devils Lake.

PERSICARIA J. de Manliis ex Brunfels Herb. Viv. Ic. II: 173. (1531). Tour. Êls. Bot. 410. (1694).

Section *POTAMOCALLIS* Nwd. A. Midl. Nat. II: 216. (1912)

352. **Persicaria rigidula** (Sheldon) Greene in Leaflets, Vol. I, p. 24 and 29. (1904).

Presenting four phases: (a) aquatic, extremely rare; (b) semi-aquatic; (c) riparian; and (d) terrestrial, which is sterile.

Leeds, Butte.

353. **Persicaria ammophila** Greene, l. c., p. 471, and Am. Midl. Nat. Vol. II., p. 236. (1912).

Fargo (Cl. Waldron).

354. **Persicaria** sp. (terrestrial phase), Thorne (Rolette Co.).

355. **Persicaria Hartwrightii** (A. Gray) Greene in Leaflets l. c. p. 24. (1904), and in Am. Mid. Nat. II. p. 15. (1911). Riparian phase. Pleasant Lake

Section *EUPERSICARIA*.

356. **Persicaria lapathifolia** (Linn.) S. F. Gray, Nat. Arr. II, p. 270. (1821).

Polygonum lapathifolium Linn. Sp. Pl. 360. (1753).

Leeds.

357. **Persicaria lapathifolia nodosa** (Pers.) Lunell.

Polygonum lapathifolium nodosum (Pers.) Small, Mem. Torr. Bot. Club 5: 140. (1894).

Polygonum nodosum Pers. Syn. I: 440. (1805).

Kulm (Brenckle).

358. **Persicaria pennsylvanica** (Linn.) Small, Fl. S. E U. S. p. 377. (1903).

Polygonum pennsylvanicum Linn. Sp. Pl. 362. (1753).

Fargo (O. A. Stevens).

359. **Persicaria maculata** Enricius Cordus, Botanologicon. (1551).

Persicaria maculosa Trew. Herb. Blackw. t. 118. (1754).

Polygonum Persicaria Linn. Sp. Pl. 361. (1753).

Leeds, Willow Creek at Dunsieth.

360. **Persicaria tomentosa** (Schrank) Bicknell.

Polygonum tomentosum Schrank, Baier. Fl. I. p. 669. (1789).

Leeds.

361. **Persicaria tomentosa glabrior** Lunell. var. nov.

Tomentum tenue, evanescens.

With a thin, vanishing tomentum.

In high grass on the dried-up bottom of Lake Ibsen, Benson Co.

POLYGONUM Disocorides IV: 4. Plinius XXVII: 12. Tour. Els. p. 411. (1694). *Polygonum* Linn. in limited sense.

362. **Polygonum aviculare** Linn. Sp. Pl. 362. (1753).

Leeds, Butte, Oberon.

363. **Polygonum littorale** Link in Schrad. Journ. 1:54. (1799).

Leeds, Butte.

364. **Polygonum erectum** Linn. Sp. Pl. 363. (1753).

Leeds.

365. **Polygonum ramosissimum** Michx. Fl. Bor. Am. 1:237. (1803).

Leeds, Butte, Towner; Kulm (Brenckle).

366. **Polygonum ramosissimum latius** Lunell, var. nov.

Perviridis. Folia typo ampliora, latiora.

Rather green. Leaves larger and broader than the type.

Railroad banks, Leeds.

BILDERDYKIA Dumortier, Fl. Belg. Stam. 18. (1827).

367. **Bilderdykia Convolvulus** (Linn.) Dum. l. c.

Polygonum Convolvulus Linn. Sp. Pl. 364. (1753).

Leeds, Butte.

368. **Bilderdykia Convolvulus pumilio** Lunell, in Am. Midl. Nat. Vol. II, p. 288. (1912).

Leeds.

369. **Bilderdykia scandens** (Linn.) Lunell.

Polygonum scandens Linn. Sp. Pl. 364. (1753).
Peninsula of Lake Ibsen, Jamestown.

Order 21. CARYOPHYLLINEAE.

Bartling, Ord. Nat. p. 295, (1830), Bart, et Wend., II., p. 137, (1824–5).

Family 38. **SALSOLACEAE** Linn., Classes Plantarum (1738).

BOTRYS Dioscorides III: 130. Plinius, Nat. Hist. XXVII: 8. 31. Bauhin, Pinax p. 138. (1623), Tour. Els. p. 406. (1694). *Vulvaria* Dallchamps, Hist. p. 543. (1587), Bubani, Fl. Pyr. I. 174. (1897).

370. **Botrys aromatica** (Spach). Nwd. Am. Midl. Nat. Vol. III. p. 275. (1914).

Botrydium aromaticum Spach, Hist. p. 295. *Chenopodium Botrys* Linn. Sp. Pl. 219. (1753). *Vulvaria Botrys* (Linn.) Bubani l. c. p. 177.

Fargo (Cl. Waldron).

371. **Botrys glauca** (Linn.) Nwd. Am. Midl. Nat. Vol. III. p. 275. (1914).

Chenopodium glaucum Linn. Sp. Pl. 220. (1753).

Leeds, York.

372. **Botrys hybrida** (Linn.) Nwd. Am. Midl. Nat., l. c.

Chenopodium hybridum Linn. Sp. Pl. 219. (1753).

Peninsula of Lake Ibsen, Willow Creek, Turtle Mountains.

373. **Botrys Fremontii** (S. Wats.) Lunell.

Chenopodium Fremontii S. Wats. Bot. King's. Exp. 287, (1871).

Peninsula of Lake Ibsen.

374. **Botrys alba** (Linn.) Nwd. Am. Midl. Nat. l. c. 276.

Chenopodium album Linn. Sp. Pl. 219. (1753).

Leeds, Butte, Narrows (Ramsey Co).

375. **Botrys alba** var. **pauper** Lunell. var. nov.

Caulis simplex vel. subsimplex. Spicae florum condensatae, sessiles vel subsessiles.

Stem simple or almost branchless, with flower clusters crowded, sessile or nearly so.

Dry bottom of coulée, Leeds.

376. **Botrys pagana** (Reichenb.) Lunell.

Chenopodium paganum Reichenb. Fl. Germ. 579. (1830).

Leeds, Bismarck.

377. **Botrys ferulata** Lunell.

Chenopodium ferulatum Lunell, Am. Midl. Nat. Vol. III p. 345 and p. 4. (Contents). (1914).

Bismarck on the banks of the Missouri.

378. **Botrys leptophylla** (Moq.) Nwd. Am. Midl. Nat. l. c. p. 275.

Chenopodium album leptophyllum. Moq. in D C. Prod. XIII, 2, p. 71. (1849).

Bismarck; Dickinson (O. A. Stevens).

379. **Botrys pratericola** (Rydb.) Lunell.

Chenopodium pratericola Rydb. Bull. Torr. Bot. Club. 39: 310. (1912).

Butte, Pleasant Lake, Narrows (Ramsey Co.).

380. **Botrys subglabra** (Wats.) Lunell.

Chenopodium leptophyllum subglabrum Wats, *Chenopodium subglabrum* (Wats.) A. Nels. Bot. Gaz. 34: 362. (1902).

Dickinson (L. R. Waldron).

381. **Botrys succosa** (A. Nels.) Lunell.

Chenopodium succosum A. Nels. Bot. Gaz. 34: 361. (1902).

Plant green, very succulent, sending out all along the stem straw-colored branches, which are longest and strongest at its base, thus arranged similarly to *B. pagana*. Stamens 5.

Leeds.

382. **Botrys rubra** (Linn.) Lunell.

Chenopodium rubrum Linn. Sp. Pl. 218. (1753).

The whole plant dark red, rather leathery than succulent, branching from the upper part of the stem like *B. alba*, Stamens 1–2.

Leeds, Minnewaukan.

[The validity of *B. succosa* has been questioned of late, the examinations apparently having been made on dry specimens. With the succulence of the former eliminated by the drying process and the different colors in both species changed to a dusky gray, common for both, their general appearance shows a similarity not existing in the fresh plants.]

383. **Botrys humilis** (Hooker) Lunell.

Chenopodium rubrum humile (Hook.) Wats. Bot. Cal. 2: 48, (1880).

Butte.

MONOLEPIS Schrad.

384. **Monolepis nuttalliana** (Roem. et Schult.). Englm. Trans. Amer. Phil. Soc. n. ser. 12:206. (1861).

Blitum Nuttallianum Schult. Mant. I: 65. (1822).

Leeds; Pingree (Stutsman Co.).

ATRIPLEX Hippokrates, Theophrastus VII: 1, Plinius, XX: 20, Columella III: 11, X: 377. Dioscorides 11: 145, Tour. Els. 405. (1694).

385. **Atriplex hortensis** Linn. Sp. Pl. 1053. (1753).

Probably an escape from former cultivation, Leeds.

386. **Atriplex carnosa** A. Nels. Bot. Gaz. 34:361. (1902)

Leeds, Minnewaukan, Towner.

387. **Atriplex argentea** Nutt. Gen. I:198. (1818).

Leeds, Bottineau.

388. **Atriplex canescens** (Pursh) James, Trans. Am. Phil. Soc. (II) 2:178. (1825).

Calligonum canesens Pursh, Fl. Am. Sept. 370. (1814).

West of Missouri River.

389. **Atriplex Nuttallii** Wats. Proc. Am. Acad. 9:116. (1874).

Leeds, Brinsmade, and in the western part of the state.

390. **Atriplex ovata** Rydb.

Glen Ullin (Bergman).

SUCKLEYA Gray, Proc. Am. Acad. XI, 103 (1876).

391. **Suckleya Suckleyana** (Torr.) Rydb. Mem. N. Y. Bot. Gard. I:133. (1900).

Obione Suckleyana Torr. Pac. R. R. Rep. 12: 47. (1860).

Suckleya petiolaris Gray, Proc. Am. Acad. XI: 103. (1876).

Belfield (O. A. Stevens).

EUROTIA Adans. Fam. Pl. 2: 260. (1763).

392. **Eurotia lanata** (Pursh) Moq. Enum. Chenop. 81. (1840).

Diotis lanata Pursh. Fl. Am. Sept. 602. (1814).

Hebron (Bergman).

KOCHIA Roth; Schrad. Journ. Bot. I: 307, pl. 2. (1799).

393. **Kochia Scoparia** (Linn.) Roth; Schrad. Neues Journ. Bot. 3:85 (1809).

Chenopodium Scoparia Linn. Sp. Pl. 221. (1753).

Introduced. Jamestown, Bismarck.

394. **Kochia trichophylla** Host.

Leeds. Established almost everywhere within the incorporation.

CORISPERMUM Jussieu, Act., p. 244. (1712).

395. **Corispermum simplicissimum** Lunell, in Am. Midl. Nat. Vol. I, p. 207. (1910).

On a lake shore southeast of Barton, Pierce Co.

396. **Corispermum villosum** Rydb. Bull Torr. Bot. Club. 24:191. (1897).

Shore of Lake Ibsen (extinct); banks of the Missouri at Bismarck (Brenckle).

SPINACEA. Tragus in Brunfels, Herb. Viv. Ic. II, 159 (1531). Also Linn. Sp. Pl. 1027 (1753).

397. **Spinacea oleracea** Linn. l. c.

An occasional escape from cultivation. Leeds.

SALICORNIA Linn. Sp. Pl. 3. (1753).

398. **Salicornia rubra** A. Nels. Bull. Torr. Bot. Club 26. (1899).

Leeds, Mud Lake, Minnewaukan.

399. **Salicornia rubra prona** Lunell, Am. Midl. Nat. Vol. I. p. 236. (1910).

Devils Lake.

DONDIA Adans. Fam. Pl. 2: 261. (1763).

Suaeda Forsk. Fl. Aeg. Arab. 69, pl. 18b. (1775).

400. **Dondia erecta** A. Nels. Bot. Gaz. 34: 364. (1902).

Suaeda erecta (Wats.) A. Nels. in Coult. and Nels. New Man. Rocky Mt. Bot. 169. (1909).

Suaeda depressa erecta Wats. Proc. Am. Acad. 9: 90. (1874).

Leeds, Minnewaukan, Towner.

401. **Dondia depressa** (Pursh) Britt. in Britt & Brown, Illustrated Flora I: 585. (1896).

Salsola depressa Pursh, Fl. Am. Sept. 197. (1814).

Suaeda depressa S. Wats. in King's Geol. Expl. 5: 294. (1871).

Leeds, Butte, Peninsula of Lake Ibsen.

SALSOLA Caesalpinus [Herb. Thornab., 205: 571. (1563)]. De Plantis, p. 170. (1583).

402. **Salisola pestifer** A. Nels. in Coult & Nels., New Man. Rocky Mt. Bot. 169. (1909).

Salsola Tragus Am. authors, not *S. Tragus* Linn.

Leeds, and everywhere.

Family. 39. **AMARANTHOIDEAE** Vent. Tabl. II : 264. (1799).

AXYRIS.

403. **Axyris amaranthoides** Linn.

An asiatic weed, well established in the Turtle Mountains. Of late found at Leeds, Butte and Pleasant Lake.

GALLIARIA Bubani, Fl. Pyr. I: 184. (1897).

Amaranthus Tour. Els. p. 201. (1694), Linn Syst. (1735), etc., not *Amaranthus* Plinius XXI: 8, 23 and ancients, this being *Celosia* Linn.

404. **Galliaria retroflexa** (Linn.) Nwd. Am. Midl. Nat Vol. III, p. 278. (1914).

Amaranthus retroflexus Linn. Pl. 991. (1753).

Leeds.

405. **Galliaria blitoides** (S. Wats.) Nwd. Am. Midl. Nat. l. c.

Amaranthus blitoides S. Wats., Proc. Am. Acad. XII: 273, (1877).

Leeds.

406. **Galliaria graecizans** (Linn.) Nwd. Am. Midl. Nat. l. c.

Amaranthus graecizans Linn. Sp. Pl. 990. (1753).

Amaranthus albus Linn. Sp. Pl. 1404. (1763).

Leeds.

ACNIDA Mitchell, ex Linn. Act. Ups. 1741. (1746).

407. **Acnida tuberculata** Moq. in D.C. Prodr. 13, p. 2, 278. (1849).

Fargo (Bergman).

408. **Acnida tuberculata prostata** (Uline et Bray).

Acnida tamariscina prostata Uline et Bray, Bot. Gaz. 20; 158. (1895).

Leeds.

Family 40. **CORRIGIOLACEAE.** Reichenb. Moessl. Hand., I, 51 (1827).

PARONYCHIA Adans. Fam. Pl. 2: 272. (1763).

409. **Paronychia sessiflora** Nuttall, Gen. !: 160. (1818).

Minot.

Family 41. **NYCTAGINEAE** Vent. Tabl. II: 271. (1799).

ALLIONIA Loefling, Iter Hispanicum 181. (1758).

Oxybaphus L' Her. Willd. Sp. Pl. I: 185. (1797).

410. **Allionia linearis** Pursh. Fl. Am. Sept. 2: 728. (1814).

Oxybaphus augustifolius (Nutt.) Sweet, Hort. Brit. I: 334 (1826.)

Morton County (W. B. Bell.).

411. **Allionia aggregata** (Ortega). Spreng. Syst. I: 384. (1825).

Calymenia aggregata, Ortega, Nov. Rar. Pl. 8: pl. 11, (1798).

Butte, (?); Lisbon 1891 (Standley, Contr. U. S. Nat. Herb. Vol. XII. part 8: 344. 1909).

412. **Allionia decumbens** (Nutt.) Spreng. Syst. l. c.

Calymenia decumbens Nutt. Gen. I: 26. (1818).

Oxybaphus decumbens Sweet, Hort. Brit. l. c.

"On high, bare, gravelly hills near Fort Mandan on the Missouri" (type locality). Medora (H. L. Bolley).

413. **Allionia decumbens assurgens** Lunell. Am. Midl. Nat. Vol. II, p. 123. (1911).

Pleasant Lake.

414. **Allionia nyctaginea** Michx. Fl. Bor. Am. I: 100. (1803).

Oxybaphus nyctagineus Sweet, Hort. Britt. I: 224. (1825).

Leeds, Devils Lake.

415. **Allionia hirsuta** Pursh, Fl. Am. Sept. 2: 728. (1814).

Oxybaphus hirsutus Sweet, Hort Brit. I: 334. (1825).

416. **Allionia pilosa** (Nutt.) Rydb. Bull. Torr. Bot. Club 29 690. (1902).

Calymenia pilosa Nutt. Gen. I:26. (1818).

Butte, Pleasant Lake, Dunsieth, Minot; Walhalla (L. R. Wal dron); Hillsboro (A. B. Lee).

417. **Allionia pilosa parva,** a depauperate from with narrow leaves. Name proposed by Prof. Robinson for the variety.

418. **Allionia pilosa rotundifolia** "Seems to be a form of this species. It appears to be a depauperate state." (Paul C. Standley, Contr. U. S. Nat. Herb. Vol. XII, part 8: 354. (1909)).

Allionia hirsuta rotundifolia Lunell, in Bull Leeds Herb. no 2, p. 6. (1908).

Leeds.

Family 42. **PORTULACEAE** Jussieu, Gen., p. 312. (1789).

PORTULACCA Plinius XX: 20. Tour. Els. p. 203. (1694).

419. **Portulacca sylvestris** Fuchs Hist. Stirp. p. 113. (1542), Tragus, Matthioli, Anguillara, Dodonaeus, Camerarius, etc.

Portulacca oleracea var. β. Linn. Sp. Pl. 445. (1753).

Leeds.

420. **Portulacca grandiflora** Hook Bot. Mag. Pl. 2885. (1829).

An occasional escape. Leeds.

(To be continued.)

THE NAIADES OF MISSOURI.—V.

BY WILLIAM I. UTTERBACK.

Genus, **Strophitus** Rafinesque.

1820—*Strophitus* Rafinesque, Ann. Gen. Sci. Phys. Brux., p. 316
1852—*Uniopsis* Agassiz, Arch. fur Naturg., p. 49.

(Type, *Anodonta undulata* Say).

ANIMAL CHARACTERS:—Branchial opening densely papillose; anal papillose or crenulate; mantle connection between anal and supra-anal not long and bordered by square, black spots; inner gills larger, inner laminae free from, or united to, the visceral mass; palpi united antero-dorsal for most of their length; color of soft parts variable but with the tendency to have certain parts (such as foot, adductors, mantle edge at branchial opening) orange in color; marsupium peculiar, consisting of ovisacs divided into many compartments at right angles to the laminae; conglutinates short, solid cords, (termed *placentulae* by Ortmann.)

SHELL CHARACTERS:—Shell, subrhomboid to subelliptical, subsolid, inflated, with low post-umbonal ridge; disk smooth; beaks rather full, sculptured with rather heavy concentric bars upcurved behind; epidermis rayed or rayless, polished; hinge teeth mere rudiments, sometimes entirely absent.

Because of the great specialization in marsupial structure, the tendency of the inner lamina of the inner gill to become connected to the visceral mass and also because of a more developed hinge, this genus is the highest of the *Anodontinae*. It is represented in this State only by *S. edentulus*.

Strophitus edentulus (Say.)

("Squaw-Foot," "Creeper.")

Pl. XXIV, Figs. 80 A—D.

1820—*Alasmodonta edentula* Say, New Harm Diss., II, No. 22, p. 340.
1888——*Anodonta shafferiana* B. W. Wright, Check List.
1900b—*Strophitus edentulus* (Say) Simpson, U. S. Proc. Nat. Mus., XXII, pp. 616–618.

ANIMAL CHARACTERS.

NUTRITIVE STRUCTURES:—Branchial opening doubly papillose; anal with inner edge crenulated, supra-anal moderately

connected to anal, mantle edge here blocked in black at regular intervals; inner gills much wider and longer than outer, inner laminae connected about one-half way; palpi united almost to their tips antero-dorsad; color of foot, palpi and adductors orange, variable with age.

REPRODUCTIVE STRUCTURES:—Marsupia occupying outer gills with secondary water tubes, ventral edges distended when gravid, ovisacs occupied by several other smaller sacs arranged crosswise facing the outer and inner laminae in which small, solid white cords (*placentulae*), containing the ova or two to ten larvae, are situated; glochidia large, spined, spadiform, hinge line straight, length greater than height, (0.35x0.285 min).

SHELL CHARACTERS.

EXTERNAL STRUCTURES:—Elongate-ovate, moderately solid, inflated, post-umbonal ridge usually rounded; female shell more obtusely (or biangulated) posteriorly than male; umbones rather full sculptured by two or three very coarse, wavy concentric ridges abruptly bent up behind; disk not sculptured; epidermis usually a glossy brown, sometimes marked by bright green rays, especially in young shells.

INTERNAL STRUCTURES:—Cardinals almost obliterated, more pronounced in left valve, where it is rounded and placed just under the beaks; laterals and interdentum lacking; umbonal cavities deeper in female shell; nacre variable from solid salmon or white, to cream or pearl-blue color.

Sex	Length		Width		Diameter	Um. ra.	Locality
♀	95	x	55	x	38—mm—	0.360—	(Marais des Cygnes R., Rich Hill, Mo.,)
♂	77.5	x	45.5	x	27 —mm—	0.430.	(Osage R., Linn Cr.,)
♀	34	x	20	x	14 —mm—	0.330	(102 R., Wyeth, Mo.,)
♂	41	x	24	x	13.5—mm—	0.335	(Grand R., Darlington.)

The last two measurements are *those of the only shells of edentulus found in the interior north of the Missouri River and these are juveniles.* Unlike most adolescent shells of this species, both shells are uni-colored except for a single brownish band parallel with the growth lines near the ventral margin on a back-ground of yellowish-green; hinge teeth and beak sculpture typically *strophitus;* nacre of both about the same; shell thin and transluscent.

MISCELLANEOUS REMARKS:—*S. edentulus* is rather easily recognized even through casual observation by its somewhat

inflated elliptical shape with the beak sculpture or coarse concentric bars bent up behind, but, most of all, by its very peculiar marsupial characters which are an adaption to its eccentric habit of independent metamorphosis. This and *Lastena ohiensis* are the only species on record so far that do not normally possess a fish host for the metamorphosis of its larva. This species is not so particular about its habitat and hence it has one of the widest distributions of any species in the United States. It is strange that it should not have a wide distribution throughout the State. It is almost unknown for the interior of North and Northwest Missouri, and is perhaps best represented in numbers and typical form in the Osage basin. Its sub-species, *pavonius* Lea (which, at best, is *perhaps only a color-variant*) is not found in this State. The shell of this species is exceedingly variable, for this State, as to its shape, size and thickness, but these variations are only individual characteristics or deviations due to special local conditions. The author has found the breeding season of *edentulus* to be about as long and over-lapping as that of *Lasmonos fragilis;* however, there was a short interim noted in most individuals about the middle of July when there was more or less sterility. Because of the *great vitality and nonparastic life of the larvae* and also because of its constancy in breeding season, we might conclude the reasons for its prolificacy and wide geographic distribution; we might conclude, too, that its distribution may be due also to a dependent life as well upon fishes of those larvae that have been observed to escape from the extruded *placentula*, and, as some students have advanced, the buoyancy of the *placentula*, bearing the juveniles, may be the greatest cause for the wide distribution.

Sub-family **Lampsilinae** Ortmann.

1911a—Lampsilinae Ortmann, An. Car. Mus., IV, pp. 337-338; 1912b, An. Car. Mus., VIII, pp. 300-360.

ANIMAL CHARACTERS:—Mantle edge antero-ventrad to branchial opening of the female with special structures, such as papillae, flaps, etc., siphonal openings with tendency to become tubular; supra-anal separated from anal by a mantle connection of medium length; inner laminae of inner gills generally connected with the visceral mass throughout; palpi medium to small; marsupium occupying only the outer gills, or parts of the latter, situated in their posterior portion as a rule; when sterile an extra thickness

of tissue on the ventral border to permit a bulging out; when gravid ovisacs are undivided internally, and distal ends are extended beyond the original edge externally; glochidia of both *Propter* ("ax-head") and *Lampsilis* ("apron-form") types, varying much in shape an size; conglutinates white, undivided at their distal ends, discharged more or less broken through the thin ventral edges of the ovasacs; color of soft parts modest, never so bright with tinges of yellow or red as seen in the other sub-families, *Unioninae and Anodontinae.*

SHELL CHARACTERS:—Shell rounded, sub-elliptical or elongated; beak sculpture generally obscure, when present usually the double looped type, rarely concentric; epidermis rarely dull, usually with bright color markings; hinge teeth rarely reduced, generally complete with well developed teeth; sex dimorphism of shell in most cases well expressed by a truncated or blunted posterior end, by an expanded post-ventral portion, etc.

MISCELLANEOUS REMARKS:—With regard to marsupial structure the Missouri *Lampsilinae* naturally fall into three groups. All these agree, however, in the extension of the membranes beyond the ventral edge of the marsupium when gravid; hence this distention tends to make the membranes thinner so that osmosis may be facilitated. To aid further in this osmotic action, there is a tendency in the three following types to draw the marsupium back toward the branchial opening where there is the greatest amount of aëration due to the action of papillae, caruncles, flaps, etc.

1. *Ellipsaria–Group.* Marsupium most primitive in that the whole outer gill is occupied; yet advantage is secured for the aëration of the embryos in rendering the ventral edges thin by distention and in throwing the marsupia into folds, thus increasing the surface for greater exposure to the water currents. The only representative in this state is *E. clintonensis* (Simpson).

2. *Obliquaria–Cyprogenia–Group.* Number of ovisacs reduced, but each greatly enlarged and elongated and placed at the greatest vantage point for oxygenation of the embryos. This group is represented in Missouri by only two species, *Obliquaria reflexa* (Raf.) and *Cyprogenia Aberti* (Conrad). The former has its few large ovisacs drawn back beyond the middle of the gill, while the latter has its ovisacs slightly in front of the middle of the gill, but extremely elongated into upward coiled spirals.

3. *Proptera–Lampsilis-Group.*_ In this division the best adaptation for the proper respiration of the embryos is secured by situating the numerous, dilated ovisacs in a more or less kidney-shaped marsupium near to the branchial opening where the postero-ventral margin of the mantle is set with papillae, flaps, etc. The first members of this group have this mantle edge only slightly crenulate and lamellate, while beyond the genus, *Protera*, is the culmination of the modern structure in the arrangement of the inner edge with papillae or flaps close to, or remote from, the outer edge. This group is represented by about thirty species in this State.

It may be added that the *Lampsilinae* are dissimilar to the *Unioninae* in their breeding season in that practically all the species are long period breeders (bradytictic), but that the glochidia of these two sub-families are similar in form and in being spineless. It is especially to be noted that the members of these two sub-families have developed perfect hinges in the adult shell, whereas those of *Anodontinae* possessing glochidia with spines have defective hinges. We should also note that the *Lampsilinae* are able to spread their valves far apart—a habit which may have some relation to the differentiation of their mantle margins in admitting greater incurrents of water—while the *Unioninae* and *Anodontinae* show a primitive character in being unable to force their valves far apart and accordingly in not developing stronger papillae and more extended mantle edges at their siphonal openings—a defect that may be somewhat counterbalanced by the delvelopment of larger palpi than is very often seen in the *Lampsilinae*. It may be stated further that there is not such intergradation of forms in this sub-family as seen among the *Unioninae*, or even as noticed among the *Anodontinae* as there seems to be more distinctness and fixity of characters among the several genera, especially as seen in the marsupial structures upon which a good key is built.

Genus **Ellipsaria** Rafinesque.

1820—*Ellipsaria* Rafinesque, Monog. Biv. Shells of R. Ohio., Ann. Gen. Sci. Phys.

1900b—*Ptychobranchus* Simpson, Proc. Ac. N. Sci. Phila., p. 79.

(Type, *Ellipsaria fasciolaris* Rafinesque 1820 = *phaseolus* Hildreth, 1828).

ANIMAL CHARACTERS:—Branchial opening with papillae; anal separated from supra-anal by short mantle connection but never lacking; inner laminae of inner gills, more or less free from visceral mass; palpi very small, connected about one-fourth of their length; color of soft parts mostly whitish with mantle edge black along the siphonal openings; marsupium occupying whole outer gill with a number of folds; ventral edge, when gravid, presenting a beaded appearance; glochidia medium in size, subovate; conglutinates white, solid, subcylindrical.

SHELL CHARACTERS:—Shell subelliptic rather elongate, arched dorsad, disk smooth; beaks low, sculpturing indistinct, finely concentric, later bars, however, somewhat double-looped; epidermis yellowish to olivaceous, painted with capillary-like rays forming interrupted squarish spots; hinge teeth well formed, branchial impression of female shell very distinct, nacre white to pearl blue.

MISCELLANEOUS REMARKS:—This most primitive genus of *Lampsilinae*, like those of *Anodontinae* and some genera of *Unioninae*, uses the whole outer gill as a marsupium but shows modern character in the special structure of folding. *Ellipsaria* is only represented in this State (and perhaps only for the whole Southwest) by *E. clintonensis* Simpson. Since the shell of this species is about the same form as that of *dilatata* (Raf.) it is often confused with this species of *Elliptio* from which is widely separated by a sub-family. The real test of distinction between these two species is concerning the marsupial characters; hence we see here an instance of shell characters as a poor guide for discrimination even for species of very distant relation.

Ellipsaria clintonensis (Simpson.)

("Kidney Shell.")

Pl. *XXV, Figs. 81 A and B.*

1900a—*Ptychobranchus clintonensis* Simpson, Pr. Acad. Nat. Sci. Phila., Pt. I, p. 79, pl. V., fig. 3; 1900b, Proc. U. S. Nat. Mus., XXII, p. 613.

1906—*Ptychobranchus clintonense* (Simpson) Scammon, Sci. Bull, Univ. Kans., III, p. 319.

ANIMAL CHARACTERS:—Identical with those of the type for this genus as to its nutritive structures and also as to the repro-

ductive as far as able to determine from sterile material that is only at hand. Glochidia not known.

SHELL CHARACTERS.

EXTERNAL STRUCTURES:—Shell elongate-elliptical moderately inflated, obtusely rounded before, pointed behind, dorsal line acurate, ventral with a slight long upward curve; disk smooth; post-umbonal ridge rounded; beaks low, faintly sculptured concentrically across two radiating ridges; epidermis olive green or yellowish rayed with capillary lines, some arranged in bundles.

INTERNAL STRUCTURES:—Cardinals double in both valves, post-cardinal of right valve rudimentary; interdentum long, rather narrow, notched; scars well impressed; beak cavity shallow branchial, however, large with deep impression in female shell; nacre white to pearl blue.

Sex	Length		Height		Diameter	Locality
♀	95	x	50	x	28	——(Spring R., Webb City)
♀	86	x	44	x	25	——(White R., Hollister)
♂	85	x	45	x	24	——(Jack's Rork, Shannon Co.)
♀	60	x	30	x	17.5	——(White R., Hollister)

This last specimen being young and well preserved shows the fine characteristic rays more distinctly and while the beak sculpture would show more distinctly than in older shells yet it is even obscure here and does not add anything to the above description of the external shell structures.

MISCELLANELUS REMARKS:—Before Simpson had studied the soft parts of this species he had considered it as *E. dilatata* (=*U. gibbosus*); however, its peculiar marsupial characters would not only discriminate, but also its different beak sculpture and dissimilar hinge. The beak sculpture of *dilatata* is one of the most emphatic among the *Naiades* while that of this species is one of the most obscure; besides the interdentum of the former is broader and thicker while the branchial impression of *clintonensis* distinguishes it from all other species outside of its genus. This species lies very close to its fellow, *facsiolaris*, and it is considered by some as merely a variety of it, but perhaps it is a *good species* on account the lack of the splotched rays and larger, heavier, thicker shell of the type for *Ellipisaria*.[1] *Clintonensis* is abundant

[1] Recent studies by Dr. Ortmann and Mr. Frierson have resulted in the positive conclusion that the *Unio occidentalis* Conrad (Monog., VII,

locally in the White, Black, and Neosho River basins. Simpson reports it for the Red River, Arkansas; Prof. Isely and Rev. Wheeler also report it for Arkansas and Oklahoma. Thus it seems to have supplanted *fasciolarsis* (=*phaseolus*) of the Tennessee drainage for the Southwest.

Genus **Obliquaria** Rafinesque.

1830—*Obliquaria* Rafinesque, Ann. Gen. Sci. Phys. Brux., p. 301. 1900b, Simpson, p. 610.

(Type *Obliquaria reflexa* Rafinesque.)

ANIMAL CHARACTERS:—Branchial opening large with papillae; anal crenulated; supra-anal high with moderately short mantle connection to anal; inner laminae of inner gills free from the visceral mass except for a short distance anteriorly; palpi short and small; soft parts grayish; marsupium occupying only outer gills and consisting of 5–7 ovisacs placed posterior to the center of the gill and when gravid extending far beyond the edge of sterile marsupium; glochidia medium in size, semicircular, hinge-line with a slight up-curve in centre; conglutinates large, white, club-shaped, glochidia scattered all through the conglutinated mass.

SHELL CHARACTERS:—Shell medium in size, thick roundly trigonal, inflated; disk of one valve with row of large knob-like nodules running from beaks centrally ventrad and alternating with the knobs on the other valve; beaks sculptured with two or three concentric bars which, although heavy, are not well defined; epidermis greenish-yellow to brown with paintings of numerous interrupted rays; cardinals prominent and ragged; laterals short nearly straight; beak and branchial cavities not very deep; nacre white; female shell smaller and slightly inflated post-ventrad.

MISCELLANEOUS REMARKS:—*O. reflexa* is the type and only member of this genus known thus far and is one of the most easily identifiable of all the *Lampsilinae* not only in its most unique marsupium, but also in the knobbed sculpture of its disk. The sex dimorphism of the shell for this type is rather peculiar as

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1836, pl. XXXVI, fig. 23) is the *Pty. clintonense* Simpson (1900-a and b) and hence this species, whose *type locality is the Current River, Missouri,* should be:—*Ellipsaria occidentalis* (Conrad).

described above and is not often seen among the *Naiades*. In that there are not such advantages for the aëration of the embryos and also a greater reduction in the number of ovisacs as seen in most other genera of this sub-family, this genus is given a primitive grouping here. However, in the reduction of the number of ovisacs a compensation is made in the enlargement and elongation. This genus has a rather wide distribution over the northern and central parts of the state, but is entirely absent from the drainage of the south slope of the Ozarks.

Obliquaria reflexa Rafinesque.

("Horny-Back," "Three-Horned Warty-Back.")

Pl. XXV, Figs. 82 A—F.

1820—*Obliquaria* (*Quadrula*) *reflexa* Rafinesque, Ann. Gen. Sci. Phys., p. 306; Chenu. Bib. Conch., 1st ser., III, 1845, p. 19.
1823—*Unio cornutus* Barnes, Am. Jl. Sci., VI, p. 122, pl. IV, fig. 5.
1900b—*Obliquaria reflexa* (Raf.) Simpson, Proc. U. S. Nat. Mus., XXII, p. 611; Ortmann 1912b—An. Car. Mus., VIII, pp. 310–312.

ANIMAL CHARACTERS.

NUTRITIVE STRUCTURES:— Branchial opening large with light colored papillae on a black back-ground; anal crenulated; supra-anal rather large and briefly connected to anal; inner laminae of inner gills free except for a short distance anteriorly; palpi small, wide, short, connected for one-half of their length antero-dorsad; color of soft parts grayish or dirty white, mantle edges at branchial opening black, branchial papillae and inner margin of anal opening yellowish, gills of male and sterile female tan-color.

REPRODUCTIVE STRUCTURES:—Only outer gills marsupial, when sterile, the ovisacs not extending below edge of gill, when gravid larger and greatly elongated beyond the original edge, ovisacs 5–7 in number, large, club-shaped, curved post-ventrad, glochidia scattered throughout the conglutinated mass; conglutinates club-shaped, solid, white, discharged whole; glochidia semi-circular, medium in size, hinge line slightly curved upward in middle, measures 0.225 x 0.235mm.

SHELL CHARACTERS.

EXTERNAL STRUCTURES:—Shell sub-trigonal, heavy and thick anteriorly, post-dorsal line rounded; slightly incurved post-

ventrad in male, slightly swollen in female; whole shell medium in size, small but more inflated; disk from beaks to central-ventral edge sculptured with a row of a few large knobbed tubercles, those of one valve alternating with the knobs of the other; post-umbonal ridge with corrugations; epidermis yellowish-green to dark brown.

INTERNAL STRUCTURES:—Cardinals upright, jagged; laterals short, nearly straight at right angles to a rather broad interdentum beak and branchial cavities moderately deep; nacre a pure, stippled white.

Sex	Length		Height		Diameter	Locality
♂	68	x	55	x	35mm	(Platte R., Platte R. Station)
♀	55	x	45	x	30mm	(Marais des Cygnes, Athol)
♂	35	x	26	x	17mm	(Platte R., Dixon Falls)
♀	20	x	15	x	12mm	(Miss. R., Hannibal)
♂	20	x	14.5	x	9.5mm	(Crows Fork, Fulton)

The last two are measurements of juveniles of widely different locality under far different ecological conditions, although the shell characters are not very much different. The former shows more of a rayed olivaceous epidermis and the latter a plain straw color. The Mississippi juvenile, being more typical as in case of most shells, is described here:—Shell sub-trigonal, valves inequilateral with two knobs on one side and one on the other, darker green epidermis below the knobs, rayed with interrupted V-markings, beak sculpture irregular concentric undulations extending out on disk; nacre white, slightly tinged with pink.

MISCELLANEOUS REMARKS:—Both as to structure of shell and nutritive soft parts *O. reflexa* is rather primitive, but as to marsupial characters it naturally falls under the lower groups of the *Lampsilinae*. In North Missouri *reflexa* reaches a very large growth while in Central Missouri it averages only about one-half the size; for the two faunae this variation applies to many other species. Since Drs. Lefevre and Curtis (1912, pp. 137 and 138) have called attention to the eccentric breeding habits and glochidial behavior of *reflexa* the writer has followed up the breeding period rather closely to find that it is gravid with early and late embryos, also with glochidia, during June, July and August, but is sterile for late Fall and mid-Winter, thus showing that this species has a short period of gravidity,—a different reproductive habit from

that of most *Lampsilinae*. The fact that the mature glochidia will not leave the conglutinated form after being extrued by the mother and because of the fact, too, that artificial infection of fish cannot be induced with its glochidia would lead to believe that its metamophosis may take place without parasitism.

Genus **Cyprogenia** Agassiz.

1852—*Cyprogenia* Agassiz, Arch. fur Naturg., p. 47; 1900b, Simpson, p. 609.

(Type, *Unio irroratus* Lea.)

ANIMAL CHARACTERS:—Branchial opening with short papillae; anal finely crenulate; supra-anal closely connected to anal; mantle edge antero-ventrad to branchial opening with fine crenulations for a short distance; inner laminae of inner gills free from visceral mass except at anterior end; palpi very small, pointed, very wide gap between them and anterior attachment of outer gills; marsupium consisting of 5–7 ovisacs anterior to center of outer gills, when gravid ovisacs immensely elongated and coiled post-dorsad; conglutinates white, very long and solid, subcylindrical; glochidia semicircular, medium in size, ventral margin obliquely rounded, hinge line long and slightly upcurved.

SHELL CHARACTERS:—Shell roundly triangular, subinflated; disk with peculiar nodulat structure; beaks more or less prominent, sculpture obscure; epidermis olive, painted with mottled rays; hinge complete; beak cavities rather deep.

MISCELLANEOUS REMARKS:—The type of *Cyprogenia, irrorata*[1] (Lea), is not found in Missouri being entirely displaced by *C. Aberti* (Conrad). The variety of *irrorata pusilla* of Simpson, is so doubtfully reported for the St. Francis River that it is not listed here. Simpson is of the opinion that all *C. irrorata*, reported for the localities west of the Mississippi, are really *C. Aberti*. As to soft parts there is a similarity to those of *Obliquaria;* however, the slight differentiation of the mantle border antero-ventrad to branchial opening and also its uniquely coiled and extremely elongated ovisacs would rank it above.

[1] From Rafinesque's evident description and figures (Ann. Gen. Sci. Brux., V, 1820, p. 312, pl. LXXXII, figs. 4, 5) we should make *C. irrorata* (Lea) a synonym for *C. stegaria* (Raf.)

Cyprogenia Aberti (Conrad.)

("Young Fan-Tail.")

Pl. XXV, Figs. 83 A and B.

1850—*Unio aberti* Conrad, Pr. Ac. Nat. Sci. Phila., V, p. 10; 1854, Jl. Ac. Nat. Sci. Phila., p. 295, pl. XXV, fig. I.
1885—*Unio popenoi* Call, Bull, Washb. Col., I, p. 49, pl. II.
1900b—*Cyprogenia aberti* (Conrad) Simpson, Proc. U. S. Nat. Mus., XXII, p. 610.

ANIMAL CHARACTERS.

NUTRITIVE STRUCTURES:—Branchial opening with many short papillae; anal with finely crenulated inner edge; supra-anal separated from anal by short mantle connection; mantle edge antero-ventrad to branchial opening slightly crenulate; gills short, wide, inner wider than outer, inner laminae free from visceral mass, except for a short distance anteriorly; palpi very small, connected about one-half of their distance antero-dorsad; color of soft parts dirty white, except for the black, squarish mottlings of the mantle edges around the supra-anal opening.

REPRODUCTIVE STRUCTURES:—Marsupium formed by five to seven ovisacs originating from the edge of the outer gills antero-ventrad and extremely elongated posteriorily into a coil; conglutinates white, very long, solid, club-shaped; glochidia unkown.

SHELL CHARACTERS.

EXTERNAL STRUCTURES:—Shell sub-triangular, compressed; beaks rather pointed, sculpturing obscure; post umbonal ridge prominent with a hummocky expansion middle-ways for the female shell, not so sculptured in male; radial furrow rounded moderately wide; dorsal ridge faintly ribbed; disk entirely rugose; epidermis brownish yellow with numerous banded rays marked with mosaics of green mottlings of various patterns of geometric designs.

INTERNAL STRUCTURES:—Cardinals double in each valve; laterals double in left, single in right; interdentum long; beak cavities deep; nacre bluish, irridescent.

Sex	Length		Height		Diameter	Locality
♂	42	x	32	x	16.5	(St. Francis R., Greenville)
♀	40	x	32	x	16.0	(White R., Hollister)
♂	37	x	30	x	14.5	(" " ")
♀	30	x	22	x	11.0	(" " ")

Although the shell of the last measurement is young and well preserved, yet the beak sculpture does not even present anything very distinct. The beaks are pointed, incurved and two-ridged,—one ridge radiating off to the posterior and the other to the anterior umbonal slope. The shell in this stage resembles that of young *P. securis* from a dorsal view. The soft parts of this specimen show that its marsupial characters consist of seven sterile ovisacs originating just in front of the middle part of outer gill curved backward toward the branchial opening.

MISCELLANEOUS REMARKS:—*C. Aberti* is a rather common little shell in the White, Black and Neosho basins of this State. It is distinguished from C. *irrorata* by not being so rounded, nor so solid, rugose and ridged parallel to growth lines. It is not to say a variable shell, yet the writer has noted some with such a truncated posterior end as to suggest an approach to *irrorata*, or is probably the *C. Aberti lamarckiana* (Lea) reported for the Black River, Missouri. Specimens taken from Indian mounds in Southwest Missouri show great preservation although deposited some centuries ago. As they were placed in these graves for "food" to the departed spirit" (as was the burial custom of the aborigines) in greater quantities than other mussel shells it is evident that this species was prized above all others for its food qualities. It can be determined that the live mussels were deposited since dried muscular tissue is still adhering to the muscle scars.

Cyprogenia Aberti lamarckiana (Lea).

(Not figured, nor described.)

1852—*Unio lamarckianus* Lea ,Tr. Am. Phil. Soc., X, p. 266, pl. XVII, fig. 20.

This sub-species is simply listed for this State through a report of it by Mr. Elwood Pleas to the U. S. National Museum, where it is now on exhibit under the number, 124,630—and also through a recent report of it for the Black River, Popular Bluff, Missouri, by Mr. Walker who has received it in this same collection of Mr. Pleas, a part of which lot was sent to the Washington Museum. No data is at hand for illustration or description.

Genus **Obovaria** Rafinesque.

1819—*Obovaria* Rafinesque, J. de Phys. Chim. Hist. Nat., p. 426.

(Type, *Unio retusa* Lamarck.)

ANIMAL CHARACTERS:—Branchial and anal opening both papillose; supra-anal large, crenulated; mantle margin antero-ventrad to branchial opening slightly specialized with lamellae or crenulations; inner gills twice the width of outer, inner laminae entirely connected to visceral mass; palpi small, far removed from anterior end of outer gills; color of soft parts soiled white; marsupium consisting of many ovisacs originating from posterior half of outer gills and extending far below the ventral edge; conglutinates poorly developed, embryos being held in rather loose masses; glochidia somewhat large, semielliptical, spineless, hinge line undulate.

SHELL CHARACTERS:—Shell rounded or ovate, inflated, height, greater than length; post-umbonal ridge not distinct, disk smooth; beaks prominent, sculptured with a few indistinct, concentric, sinuate bars; epidermis brown with faint rays.

MISCELLANEOUS REMARKS:—Although this genus is another one of the primitive types of *Lampsilinae*, yet the differentiation of the mantle border antero-ventrad to the branchial opening and the tendency of the marsupium to assume the reniform shape and to acquire a position near the opening of the incoming currents all show and approach to the more modern groups. According to Dr. Ortmann the sub-genera of this genus, as fixed by Simpson, are well defined enough to be retained.

Thus we have the following grouping:—

1.—Sub-Genus **Obovaria** (*sens. strict.*)

Shell upright, oval, rather solid; beaks drawn up more toward the middle of the dorsal line; cardinals mostly normal.

Type, *O. retusa* (Lamarck.)

2.—Sub-Genus **Pseudoön** Simpson (1900b, p. 601).

Shell oblique, elliptical, solid, thick; beaks protruding anteriorly; cardinals subparallel to laterals.

Type, *O. ellipsis* (Lea)

From the above diagnoses it may seem that division is made on the shell characters, the soft parts being identical,—even in marsupial and glochidial characters. However, this Genus is

only represented in this State by *ellipsis* and that in a limited distribution both in the geographical and individualistic sense.

Obovaria (Pseudoön) ellipsis (Lea).

("Missouri Nigger-Head," "Egg Shell," "Hickory Nut.")

Pl. XXV, Figs. 84 A and B.

1828—*Unio ellipsis* Lea, Tr. Am. Phil. Soc., III, p. 268, pl. IV, fig. 4.
1900b—*Obovaria ellipsis* (Lea) Simpson, Proc. U. S. Nat. Mus.; 1912b, Ortmann, Car. Mus., VIII, pp. 323–324.

ANIMAL CHARACTERS.

NUTRITIVE STRUCTURES:—Branchial opening small with two-ranked papillae; anal finely papillose; supra-anal crenulated (a rare character) not well connected to anal; mantle border just antero-ventrad to branchial opening with crowded papillae or crenulations extending one-third of the way towards center of ventral margin; gills very wide, both blunt and pointed posteriorly, inner laminae of inner gills entirely connected to visceral mass; palpi rather small, connected about one-half of their length antero-dorsad; foot pinkish, mantle edge dark in region of siphonal openings, rest of soft parts dirty white.

REPRODUCTIVE STRUCTURES:—Marsupium occupying posterior portion of outer gills, rather kidney-shaped, consisting of several ovisacs, twenty-five or thirty which, when gravid, extend far below the original edge, pigmented purplish ventrad; conglutinates white, not well formed, ova and glochidia discharged in rather loose masses; glochidium medium in size, semi-elliptic, rather short and straight, measures 0.210 x 0.265mm.

SHELL STRUCTURES.

EXTERNAL STRUCTURES:—Shell sub-elliptical, rather oblique, very solid, thick, heavy; ventral margin more rounded than dorsal; disk smooth; no post-umbonal ridge; rest lines of growth very distinct; beaks projecting anteriorly, rather prominent, sculpturing indistinct; epidermis yellowish-horn color with green rays in young shell.

INTERNAL STRUCTURES:—Cardinals very heavy, nearly parallel to laterals with right post-cardinal converged dorsad and rounded up from a broad V-shaped gutter; interdentum broad, thick, right deeply gashed; beak cavities not very deep; nacre white.

Sex	Length		Height		Diameter	Locality
♀	80	x	61	x	47	(Grand River, Sumner)
♂	70	x	55	x	39	(Mississippi River, Hannibal)
♀	65	x	52	x	41.	(Osage River, Warsaw)
♂	30	x	24	x	18	(Mississippi River, Hannibal)
♀	25	x	20	x	14	(" " ")

Beaks of these specimens of the last two measurements very full, rounded, poorly sculptured although not eroded; more inflated (comparatively) than adult shell; epidermis olive with profuse paintings of green rays so as to give the appearance of olive green; post-ventral edge of shell more obliquely rounded than in adult; nacre pearl blue.

MISCELLANEOUS REMARKS:—From shell characters there is no real sex dimorphism except a little greater inflation in the female, but not only a less crowded arrangement of septa is seen in gills of the male but there is a more intense black pigmentation in the region of the branchial opening. *The crenulated supra-anal opening is surely a unique character and may indicate a conversion of this opening into the anal.* The bare connection between the two openings would also indicate this merging. Although of rare occurrence *ellipsis* reaches its greatest perfection for the interior in the Grand River of North Missouri. It is found occasionally in the Osage Basin, but never develops a shell as large, heavy or bright as found in the Grand or in the Mississippi. This fact of difference in size, color and solidity for the shells of these different mussel faunae applies to most other species as well. Scammon (1906, p. 306) reports this species as very active with strong musculature and that he has traced this species for fifty yards by its furrow in the Kansas River. This species is bradytictic.

Genus **Nephronaias** Crosse and Fischer.

1893—*Nephronaias* Crosse and Fischer, Miss. Sci., Pt. 7, II, p. 556; 1900b, Simpson, Proc. U. S. Nat. Mus., XXII, p. 591.

(Type, *Unio plicatulus* Charpentier.)

ANIMAL CHARACTERS:—Identical with those of Obovaria—even in glochidial characters.

SHELL CHARACTERS:—Shell rounded to sub-elliptic and elongate, usually compressed; posterior ridge rather indistinct, beaks not near the anterior end, sculpture poorly developed,—consists of a few faint double-looped bars; epidermis greenish

to yellowish, generally with very distinct green rays; sex dimorphism of shell not well shown.

MISCELLANEOUS REMARKS:—This genus is set aside solely on shell characters. The sub-genus, *Pseudoön*, serves as a good connecting link between *Obovaria* and *Nephronaias*. Chiefly because of the lack of much specialization of the mantle border antero-ventrad to the branchial opening *Unio ligamentina* (Lam.) is taken out of Simpson's grouping of it as a *Lampsilis*. In this State this genus is *best represented* by *N. ligamentina* and *ellipsiformis* (Lea).

(To be continued.)

OUR BIRDS IN THE AUTUMN OF 1914.

BY BROTHER ALPHONSUS, C. S. C.

The observation of bird life in autumn must be somewhat unsatisfactory to many lovers of nature. Not a few of the species become gradually much reduced in numbers; they are usually silent, and spend most of the day hidden away in shrubbery. Unless the observer has great enthusiasm in his work, and can devote sufficient time to it, he will not succeed in discovering but comparatively few of the many species that are still staying with us. The writer has found this to be true in his own case, and only when his efforts have been uniformly sustained day after day has he obtained such a record as is shown in the present article.

To show the truth of this statement, I may say that 35 species were recorded only once in one of the autumn months in 1914. These species were: Cardinal, Blackburnian, Wilson, Tennessee, Myrtle, Connecticut, Black-throated Blue, Warblers, Baltimore Oriole, Hummingbird, Scarlet Tanager, Phoebe, Kingbird, Red-breasted Nuthatch, Brown Creeper, Bobwhite, Ruby-crowned Kinglet, Flicker, Mourning Dove, Winter Wren, Catbird, Yellow-billed Cuckoo, Hell Diver, Blue-headed and Yellow-throated Vireos, Chickadee, Tree Fox, Lark, White-throated, Sparrows, Red-winged Blackbird, Towhee, Screech Owl, Pine Grosbeak, Mallard.

The paucity of interesting observations of the habits of the

many species mentioned in this article is due to the fact that the writer has hitherto only incidentally studied the habits of birds, his time having been mostly taken up in obtaining the largest number of species possible during the different seasons of the year. This was done to secure data about the distribution and migration of our birds.

SEPTEMBER.

1.—Heard first Blue Jay in Lawton, four miles from Bankson Lake.—2.—Arrived at Notre Dame, Ind.—Great scarcity of birds a. m. and p. m.—4.—Cardinal on hill-side near St. Joseph's Lake; red under tail but no where else; call-note.—21 species in two hours, a. m.—9.—Song of Thrasher—complete, low and sweet.—10.—A. M. Magnolia Warblers plentiful.—12.—Scarlet Tanager—body yellow, wings and tail black.—Goldfinches still in summer plumage.—18.—First Hermit Thrush, in row of box-elders—very still and hidden.—Female Tennessee Warbler.—19.—A dead Redhead in oak grove.—23.—Turned cool after a week of extremely warm weather.—Autumn migrants late.—Redstarts plentiful west of ice-house.—First Yellow Palm Warblers—plentiful in fields and along roadsides.—30.—Bluebirds and Myrtle Warblers in St. Mary's property, in field containing a few apple trees.—Golden-crowned Kinglets plentiful just inside St. Mary's gate.

There were 17 records for the Chipping Sparrows in 1913 against 2 in 1914. I often find this Sparrow rare in autumn. The Redstart had 12 records in 1913 and only 2 in 1914. As a rule I have not made many records of this warbler in autumn. Another species seldom seen at this season is the Maryland Yellowthroat—4 records in two years. In the last two years September had but 4 records for the Indigo bird; in 1912 there were 9 records. A very rare species both in spring and autumn is the Wilson Warbler—one records in September 1914 and one in August 1912.

OCTOBER.

11.—Wren-like call-note of Ruby-crowned Kinglet; a few notes of the song also. This call-note is an easy way of distinguishing the Ruby-crowned from the Golden-crowned.—Cooler after a month of dry, warm weather.—14.—Note of White-crowned Sparrow resembles one of the Meadowlark's.—Birds abundant near ice-house and in hedges along roadside.—22 species seen today.—22.—Weather fine for nearly a week.—Great increase of

many species.—A pair of Pine Grosbeaks near ice-house; male reddish on head and back; female mottled with brownish and lighter; call-note, distinctive.—25.—Musical call-note of Tree Sparrow in a field; none seen.—27.—First snowfall; few species seen.—31.—A. M.—St. Mary's property.—A large flock of Killdeers flying around a field when flushed.—Fox Sparrows and Chickadees in trees on bank of St. Joseph River.—Weather warm and day bright.

In 1913 there were 5 records for the Flicker, the last made on the 10th; in 1914 the only record for the species was on the 21st. The Tree Sparrow was recorded on 7 days in 1913 and only once in 1914. The Fox Sparrow also had 7 records in 1913 and two in 1914. The Yellow-billed Cuckoo had one record in 1914 and none in 1913. A very rare species here at all seasons of the year is the Winter Wren—one record this year.

NOVEMBER.

6.—Fine weather.—Call-note of Pine Grosbeak, flying, a. m.—8.—A number of Brown Creepers seen.—Golden-crowned Kinglets in spruce trees on Novitiate grounds.—Musical call-note of Tree Sparrow.—Snowbirds plentiful.—10.A. M.—Clear and windy.—Only 3 species seen.—12.—4:15 p. m.—Kinglets near Grotto.—Flock of birds flying high—perhaps Goldfinches.—16.—Snowstorm.—Only heard Crow.)21.—Large flock of crows in grove near Novitiate; kept moving; no time when all were resting; cawing continuously; watched them five minutes when most of them departed; a few remained even as I passed by.—22.—6:45 A. M.—Two Robins near chicken yard of Seminary.

The Meadowlark was not recorced in 1914; one record in 1913—the 4th.—The Killdeer had 2 records in 1914; none in 1913.—The Chickadee had one record in 1914 and 18 in 1913. Here is an instance of great disparity in distribution, for which this species is remarkable.—The Fox Sparrow had a single record in 1914 and none in 1913.—The same was true of the White-throated Sparrow and Bluebird.—The Kingfisher had no record in 1914 and one in 1913.—The Hairy Woodpecker had a record identical with the Kingfisher.—The Towhee and Red-winged Blackbird each had one record in 1913 and 1914.—The Golden-crowned Kinglet had 3 records in 1914 and 2 in 1913.—The Screech Owl was recorded once in 1914 and twice in 1913.—The Myrtle

Warbler had 2 records in 1914 and one in 1913.—The Hell Diver was not recorded in 1914 and was seen three times in 1913.—The Pine Grosbeak had no record for 1913.

SEPTEMBER.

Crow, 1, 4, 5 to 9, 11, 12, 13, 16, 17, 19, 20, 22 to 30.
Blue Jay, 1 to 30.
Red-head Woodpecker, 1 to 7, 9 to 24, 26 to 30.
Downy Woodpecker, 2, 4, 5, 7, 8, 14 to 24, 26, 28, 29, 30.
Goldfinch, 2 to 29.
Song Sparrow, 2 to 13, 15, 16, 18 to 30.
Vesper Sparrow, 3, 4, 15.
Field Sparrow, 3, 5, 7, 8, 9, 12 to 30.
Chipping Sparrow, 5, 16.
White-throated Sparrow, 24 to 29.
Lark Sparrow, 30.
Cardinal, 4.
Meadowlark, 17, 19, 23, 24, 27, 29, 30.
Robin, 1 to 9, 11, 14, 15, 17 to 24, 26 to 30.
Bluebird, 1, 2, 23, 28, 29, 30.
Redstart, 1, 24.
Black and White Warbler, 1, 12.
Black-throated Green Warbler, 1, 5, 11, 12, 13, 17, 18, 21, 23, 24, 27 to 29.
Pine Warbler, 8, 9, 10, 12, 13, 14, 16, 17, 21, 22, 23, 27, 30.
Ovenbird, 1, 6.
Blackburnian Warbler, 1.
Nashville Warbler, 23, 29.
Magnolia Warbler, 4, 5, 10, 13, 16, 18, 19, 21, 22.
Maryland Yellowthroat, 3, 10.
Wilson Warbler, 8.
Bay-breasted Warbler, 12, 23.
Tennessee Warbler, 18.
Yellow Palm Warbler, 23 to 29.
Myrtle Warbler, 30.
Bronzed Grackle, 2 to 8, 10, 11, 12, 14 to 24, 28, 29, 30.
Kingfisher, 1, 2, 4, 5, 7, 11, 12, 16, 17, 18, 20, 21, 23.
Mourning Dove, 2, 3, 4, 5, 7 to 10, 16, 18, 27, 29.
Cowbird, 3, 13, 18, 20.
Towhee, 25, 26.
House Wren, 1, 5, 7, 10 to 16, 18, 19, 21, 22, 25, 26, 28.
Flicker, 1, 3 to 7, 10 to 13, 16, 18 to 21, 23, 26.
Brown Thrasher, 3, 5, 10, 12, 13, 15 to 21, 23, 25, 26.
Catbird, 2, 3, 4, 7, 9 to 19.
Killdeer, 2, 4, 5, 7 to 11, 14, 16 18, 19, 21, 22, 27 to 30.
Spotted Sandpiper, 6, 11, 12.
Baltimore Oriole, 1.
Warbling Vireo, 1, 3, 4, 5, 6, 7, 12, 15.
Red-eyed Vireo, 19, 26, 27, 29
Yellow-throated Vireo, 1.
Indigo Bird, 2, 4, 18.
Nighthawk, 1, 3.
Bobolink, 3, 4, 7, 23.
Hummingbird, 1.
Yellow-billed Cuckoo, 4 to 5 19, 21 30.

Lesser Yellowlegs, 13, 17, 19.
Hell Diver, 1, 3, 5, 6.
Screech Owl, 4, 6, 11.
Scarlet Tanager, 12.
Hermit Thrush, 18, 19, 25, 27.
Chimney Swift, 2 to 8, 10 to 15, 17, 19, 20 to 24, 26, 27, 29.
Snowbird, 24, 26, 27, 28, 30.
Least Flycatcher, 5, 13, 20, 23, 24, 25.
Wood Pewee, 1 to 7, 12, 14, 15.
Phoebe, 28.
Kingbird, 3.
Red-breasted Nuthatch, 24.
White-breasted Nuthatch, 1, 3, 4, 5, 7 to 10, 12 to 15, 17 to 19, 21, 22, 23, 26, 27, 29.
Brown Creeper, 30.
Yellow-bellied Sapsucker, 27, 29, 30.
Bobwhite, 29.
Ruby-crowned Kinglet, 29.
Golden-crowned Kinglet, 29, 30.

Total number of species seen, 68.

OCTOBER.

Crow, 1, 2, 3, 5, 6, 7, 10, 11, 13 to 17, 19 to 31.
Blue Jay, 1 to 12, 14 to 31.
White-breasted Nuthatch, 4, 7, 11, 13, 14, 18, 19, 20, 26, 27, 28, 31.
Red-headed Woodpecker, 1 to 6, 11, 12, 14, 16, 18 to 23, 27, 31.
Downy Woodpecker, 1, 3, 5, 6, 7, 9, 14, 16, 17, 18, 20, 21, 24, 28 to 31.
Flicker, 21.
Song Sparrow, 1 to 9, 11 to 23, 25, 27, 28.
Field Sparrow, 1, 2, 3, 5 to 23, 26, 29.
Savanna Sparrow, 1, 3.
Lark Sparrow, 5, 17, 19.
White-throated Sparrow, 1, 2, 3, 5, 7, 9, 12 to 15, 17 to 26, 28, 30.
White-crowned Sparrow, 12, 14, 17, 18, 21.
Fox Sparrow, 19, 31.
Tree Sparrow, 25.
Bronzed Grackle, 1, 2, 3, 6, 7, 10, 12, 14, 15, 17, 18 to 23, 25.
Red-winged Blackbird, 12, 13 19
Cowbird, 2, 17, 19, 20.
Kingfisher, 14, 18.
Killdeer, 1, 2, 3, 5 to 8, 12, 14, 16, 19, 20, 31.
Mourning Dove, 14.
Towhee, 2, 3, 5, 12 to 17, 19 to 23, 25.
House Wren, 1, 4, 5, 6, 17.
Winter Wren, 17.
Chickadee, 7, 21, 31.
Red-shouldered Hawk, 13, 17.
Meadowlark, 2, 3, 5, 6, 8, 10, 11, 14, 17, 18, 19, 20, 21.
Goldfinch, 1, 2, 3, to 10, 14, 17, 19 to 24, 26, 28.
Catbird, 17.
Yellow-billed Cuckoo, 2.
Hermit Thrush, 1, 2, 3, 9, 11 to 14, 16, 17, 18, 20.
Chimney Swift, 1, 2, 3, 4, 5, 7, 8, 15.

Screech Owl, 6.
Snowbird, 1, 2, 3, 5, 7, 8, 9, 11 to 31.
Sapsucker, 1, 3, 11.
Phoebe, 2, 3, 4, 7, 13, 18, 20, 24.
Ruby-crowned Kinglet, 2, 11, 14, 20, 21, 23.
Golden crowned Kinglet, 1 to 6, 11, 12, 14, 16 to 24, 26 to 31.
Brown Creeper, 1, 12, 14, 18, 19, 26, 28, 29, 31.
Robin, 1, 2, 3, 12, 14, 16, 18, 19.
Bluebird, 3, 5, 11, 12, 14, 16, 17, 18 to 23, 25, 30, 31.
Hell Diver, 21.
Pine Grosbeak, 22.
Blue-headed Vireo, 20.
Connecticut Warbler, 20.
Black-throated Green Warbler, 5, 15.
Black-throated Blue Warbler, 18
Pine Warbler, 6, 12, 26.
Nashville Warbler, 1, 6, 11, 19.
Yellow Palm Warbler, 15, 17, 18, 20, 22, 31.
Myrtle Warbler, 1 to 4, 9, 11 to 31.

Total number of species seen, 50.

NOVEMBER.

Crow, 2, 3, 4, 6 to 10, 12 to 18, 20 to 27, 29.
Blue Jay, 1 to 12, 14, 15, 19, 20, 22 to 30.
White-breasted Nuthatch, 1, 2, 4, 6 to 9, 11 to 15, 19 to 23, 26 to 30.
Red-headed Woodpecker, 2, 7 to 9, 11 to 15, 17, 18, 22, to 25, 30.
Downy Woodpecker, 1, 2, 4, 5, 7, 8, 9, 11 to 14, 17, 18, 20 to30
Goldfinch, 3, 6, 7, 8, 11, 12 13, 17, 22, 23, 25, 28, 29.
Chickadee, 3.
Song Sparrow, 1, 3, 5, 6, 8, 9, 11, 27, 30.
Fox Sparrow, 4.
Lark Sparrow, 1.
White-throated Sparrow, 29.
White-crowned Sparrow, 5, 6.
Tree Sparrow, 4, 5, 7, 8, 11, 13, 26.
Killdeer, 2, 17.
Robin, 2, 22.
Bluebird, 2.
Red-winged Blackbird, 6.
Towhee, 11.
Screech Owl, 28.
Myrtle Warbler, 1, 21.
Borwn Creeper, 1, 6, 7, 8, 9, 11, 13, 14, 26, 28.
Golden-crowned Kinglet, 7, 8 12
Snowbird, 1 to 15, 18, 19, 21 to 30.
Pine Grosbeak, 6.
Mallard, 25.

Total number of species seee, 25.

Total number of species seen in autumn, 81.

CRITICAL NOTES OF NEW AND OLD GENERA OF PLANTS.—VI.

BY J. A. NIEUWLAND.

NYCTERIUM.

The plants now included generally in *Solanum* having the fifth stamen different in shape and usually larger than the other four well deserve by this one notable character alone, to constitute a separate genus. The name *Nycterium* for these plants was proposed by Ventenat.[1] Two species are native within the limits of this country. The genus well deserves the recognition it had already by a considerable number of noted botanists, such as Torrey, Link, Lindley, Sweet, Don, Engelmann, etc.

Nycterium Vent. l. c.

Solanum Linn., in part.

Nycterium rostratum Link, Enum. Hort. Berol I, 189 (1821).

Solanum rostratum Dunal, Sol., 234 pl. 24 (1813), *Solanum heterandrum* Pursh, Fl. Am. Sept., 156, pl. (1814). *Nycterium heterandrum* Heynh., Norm. II, 440 (1840).

Nycterium citrullifolium (Braun) Nwd.

Solanum citrullifolium Braun, Ind. Sem. Frib. (1849).

PTERETIS AGAIN.

In the September number of Rhodora Fernald[2] shows that out Ostrich Fern is really distinct from the European *Matteucia Struthiopteris* and gives it the name *Matteucia nodulosa* (Michx) Fernald (*Onoclea nodulosa* Michx.). We[3] have already pointed out that *Pteretis* Raf. (1818) antedated *Matteucia* Todara (1866). Was not perhaps *Pteretis* rejected with right for the reason given that names held to for fifty years are *nomina rejicienda* to give way to later *nomina conservanda*. A moment's reflection will show that even if the name *Matteucia* had been *universally accepted*, which is not true, it had not been accepted for fifty years at that. Then for what reason was it cast of. We had suggested several reasons why it might not prove acceptable.[4] We

[1] Ventenat, E. P., Malm. sub. t. 85 (1803).

[2] Vol. 17, p. 161 (1915).

[3] Am. Mid. Nat., Vol. III, 197 (1914).

[4] Am. Mid. Nat. l. c.

have guessed rightly, as we knew before hand we should, when so many alternatives were offered. In any case to try to determine what the "codists" of one persuasion, or the other might do in any given case where elementary logic may be thrown "to the winds" with impunity, is one of the lightest and most useless of occupations. According to the "American Code" the plant in question ought to have been called **Pteretis nodulosa** (Michx.) nov. comb., what the codists of any belief or none will call it depends to much on individual whims or so-called "interpretation" to be worth while venturing a guess, as the case in question actually showed beyond our expectation.

PSYLLIUM.

By habit as well as good characters of inflorescence *Plantago Psyllum* Linn. as also *Plantago arenaria*. stand apart so strikingly that they may well be considered in the segregated genus *Psyllium*. The genus was recognized by the ancients and many a one with fewer reasons for recognition is now maintained without question. We have often insisted that plants monoicous, and dioicous are not to be put in a genus with those, that have perfect flowers. In this very family the *Plantaginaceae* we have the genus *Limosella* that enjoys scarcely any other distinctive characters than such emphasized here and no one questions the validity thereof. Botanists would do well to be consistent in generic recognitions. The trivial name of the type *Plantago Psyllium* Linn. was used for this plant in generic designation by Dioscorides (4: 170) and was accepted by the older botanists. The plants of this proposed genus group differ from *Plantago* proper in being annual leafy-stemmed plants with flowers in capitate clusters instead of spikes. One species is reported from our region.

Psyllium (Diosc.) Juss., Gen. 90 (1789).

Psyllium arenarium (W. & K.) Mirb., Hist. XIV: 333 (1814).
Plantago arenaria W. & K., Pl. Par. Hung. I, 5: pl. 51, (1894)

MARGARITA LISTER.

The name *Margarita* Lister[1] for a plant of the *Myxomycetes* base on the type *Physarum metallicum* Berk & Br.[2] can not obtain because there is an older application of the genus name *Mar-*

[1] Lister, A., Monograph of Mycetozoa, 203 (1894).
" G., " " " 256 (1911).

[2] Mag. Zool. Bot., I, 49 (1838).

garita[3] a segregate of *Aster*, under *Aster Bellidiastrum*. To replace the invalidated and therefore inapplicable *Margarita* Lister the name *Calomyxa* may be suggested.

Calomyxa Nwd., Nom. Nov.

Margarita Lister, Mycetozoa l. c. (1894) (1911), not *Margarita* Gaudin (1829).

Calomyxa metallica (Berk. & Br.) Nwd.

Margarita metallica (Berk & Br.) Lister, l. c. *Physarum metallicum* Berk & Br., Mag. Zool. Bot. I. 49 (1838). *Cornuvia metallica* Rost. Mon. App. 35.

IN REMEMBRANCE.

RESOLVED that in the death of Doctor Edward Lee Greene the California Academy of Sciences has lost one of its most eminent members and the world one of its leaders in systematic botany. With sublime devotion to science he gave up all he had, time, energy and what money could be spared from his frugal needs to carrying on his work, publishing at his own expense a mass of original material to be compared in extent only with that of Asa Gray. Probably no other American botanist has published so many new species and genera and certainly no other has made such great sacrifices to carry on his work.

His wide travels and his rare powers of observation and discrimination gave him a personal knowledge of more living plants than is possessed to-day by any other botanist.

He collected at his own expense one of the best botanical libraries in this country and an herbarium rich in types of new species. It is greatly to be regretted that this library and herbarium are not in some Pacific Coast institution where their use would be greatest since his epoch making work was done on the Pacific Coast flora.

He possessed that rare type of courage, namely the courage of his convictions, and alone carried the banner of what to him was the truth in the face of the greatest opposition. No wonder that such a man who was also blessed with an attractive personality and whose knowledge was so great and so freely bestowed, drew

[1] Gaudin, J. F., Fl. Helv. V, 335 (1829).

to him the young enthusiasts whose ideals were as fresh as his own.

The example of his life remains to keep alive unselfish ideals and nobility of character.

The California Academy of Science has a permanent memorial of this remarkable man in his botanical papers which appeared in the two Bulletins of this institution. The herbarium also possesses many type of species described by him which were saved from the great fire. Since then he has sent to the new herbarium some valuable specimens containing duplicates of some of his types.

Our sympathy goes to those friends and relatives who have lost one who is personally beloved.

Resolved that a copy of these resolutions be sent to friends and relatives, to the Smithsonian Institution, the Biological Society of Washington, the Washington Academy of Science, Notre Dame University and the Catholic University of America.

Alice Eastwood, California Academy of Science.
Douglas H. Campbell, Stanford University.
Eugene W. Hilgard, University of California.

***

The friends of Dr. Edward Lee Greene, who died November 10, 1915, met at the home of Mrs. Margaret Downing, 1262 Lawrence Street, Brookland, D. C., Sunday afternoon, December 12, 1915.

Dr. Burns, President of the Holy Cross College, represented Notre Dame University, and about forty other intimate friends of Dr. Greene were present.

Dr. Burns stated that it was the wish of our friend that no formal services be held in Washington, but that the funeral be at Notre Dame; therefore we are assembled by the common sentiment of love, respect, and veneration for dear Dr. Greene at this informal gathering. The invitation to attend this meeting was extended to all friends, so far as was possible.

Letters of sympathy and regrets from Mrs. Senator Bourne, Dr. J. A. Zahm, and Dr. H. Hyvernat, one of the oldest professors of the Catholic University and one who had been closely associated with Dr. Greene, were read. Postmaster General Burleson was unexpectedly prevented from attending, and sent a note

expressing his regret that he could not be present to pay tribute to his good friend.

Senator Knute Nelson, of Minnesota, who knew Dr. Greene intimately as a boy, having been one of his schoolmates, expressed his gratification at being able to be present, and related how Dr. Greene became interested in botany in his younger days, having received inspiration and instruction from a Swedish botanist, Thure Ludwig Theodore Kumlien, who lived in his neighborhood. In later years the Senator found him as a professor of botany in the Catholic University, and they renewed their friendship. He spoke of him as being kind-hearted, congenial, industrious, and having a most lovable disposition; he felt that he never had a better friend in Washington. Besides being a man of the highest integrity, and entirely fearless, he was an eminent scientist, and a great scholar—not in the sense of having just one idea—his views covered more than the subject of botany; it was therefore very unfortunate that his life could not be spared much longer. "Nothing was so painful and so grievous to me as the news of Dr. Greene's death."

Mr. W. E. Safford, Secretary of the Botanical Society of Washington, in his tribute said that while Dr. Greene was a great botanist, he was not an orthodox botanist. He made it a point to do honor to those to whom honor was due, and tried to keep the memory of the very old botanists from sinking into oblivion.

Dr. W. A. Orton took pleasure in testifying to the esteem in which the younger botanists of Washington held Dr. Greene for his wonderful knowledge of ancient languages and his broad views which placed him in a unique position.

He described a meeting of the Botanical Society, given in honor of Dr. Greene, which hardly a member of the Society failed to attend. "It is now a lasting pleasure to have paid that tribute to the Doctor while he was here among us."

Dr. C. O. Townsend admired Dr. Greene greatly because he was an inspiration to every one interested in the work of botany; he often recalls the kindly expression which was on his face when he arose in the botanical meetings to address them—he seemed to tower above them all. The memory of Dr. Greene is therefore very pleasant and very beautiful.

Dr. Theodore Holm, Dr. Greene's oldest friend in Washington,

could not reconcile himself with the thought that Dr. Greene had gone, for he was his only real congenial friend in America—the only one who could fluently speak of botany and knew everything about ancient botany. His knowledge of the specific flora of America could hardly be reached by any one else; he brought out very many new points in plant descriptions. He said he could not adequately express the loss sustained in Dr. Greene's death, and he hoped that his memory would always be kept alive.

Dr. Moore, of the Catholic University, read a sketch of the life of Dr. Greene, written by Dr. J. A. Nieuwland, Editor of THE AMERICAN MIDLAND NATURALIST, published at Notre Dame University; he also paid high tribute to Dr. Greene's helpfulness to young students.

Dr. Dunn, who for a number of years was associated with Dr. Greene in the Catholic University, read from Dr. Greene's own manuscript an experience entitled "A Walk Across the Desert," a part of his autobiography.

Dr. Burns closed the meeting by reading the Thirty-Eighth Psalm as translated into English by Dr. Greene from his own Greek testament.

The following motion was introduced by Dr. V. K. Chestnut, which was seconded by Mr. Safford, and unanimously prevailed:

"We have assembled together to-day, through the kind courtesy of our esteemed hostess, to meet the friends of Dr. Edward Lee Greene, and we have been charmed by the reading from the pen of Dr. Greene himself the wonderfully interesting story of his early pioneering experiences while botanizing in the great trackless desert regions of the United States.

"We have been enabled to hear this story through the courtesy of Dr. Cavanaugh, President of Notre Dame University, to whom the manuscript of the autobiography has been entrusted, and through Dr. Dunn, of the Catholic University, who has kindly read the manuscript to us.

"I wish, therefore, to move, Mr. Chairman, that a rising vote of thanks be extended to each of these persons, and I would also include in this vote of thanks the names of our worthy presiding officer, Dr. Burns, President of Holy Cross College,. and Dr. Nieuwland, Editor of the MIDLAND NATURALIST, who so thoughtfully sent the portraits and the book plates of our most esteemed friend and fellow botanist."

Respectfully submitted,

W. G. EISENHART,

Secretary of the Meeting